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United States
Department of
Agriculture

Research and
Education Committee

September 1988

1987 Annual Report on the Food and Agricultural Sciences

From the Secretary of Agriculture
to the President and the Congress
of the United States

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PREFACE

This report was prepared under the auspices of the USDA Research and Education Committee, which was established in 1981 as a unit of the Secretary of Agriculture's Policy and Coordination Council. The Assistant Secretary of Agriculture for Science and Education serves as chairperson of the Committee.

USDA agency representatives who assisted in preparing this report were Jack H. Armstrong, Agricultural Cooperative Service; Harold S. Ricker, Agricultural Marketing Service; James T. Hall, Agricultural Research Service; Larry D. Mark, Animal and Plant Health Inspection Service; Fennie A. Tolver, Cooperative State Research Service; Verla C. Rape, Economic Research Service; Donald West, Extension Service; Leslie E. Malone, Federal Grain Inspection Service; Janet S. Wintermute, Forest Service; Alanna Mosfegh, Human Nutrition Information Service; Robert Butler, National Agricultural Library; Robert D. Tortora, National Agricultural Statistics Service; Michael L. Young, Office of Budget and Program Analysis; James S. Walker, Office of International Cooperation and Development; and Hunt B. Ashby, Office of Transportation.

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FEDERAL, STATE, AND PRIVATE INDUSTRY SUPPORT FOR THE FOOD AND
AGRICULTURAL SCIENCES

DEPARTMENT OF AGRICULTURE

The U.S. Department of Agriculture's research and education (R&E) agencies supported food and agriculture research, Extension, and teaching programs funded at approximately \$1,370 million in FY 1987, up 6.2 percent from FY 1986. These programs were centered in the Agricultural Research Service, Cooperative State Research Service, Extension Service, National Agricultural Library, Forest Service, and Economic Research Service. Other agencies having research and education activities include the Agricultural Cooperative Service, Animal and Plant Health Inspection Service, Agricultural Marketing Service, Human Nutrition Information Service, Office of International Cooperation and Development, Office of Transportation, National Agricultural Statistics Service, and Federal Grain Inspection Service. USDA research and education program funding for fiscal year 1988 is estimated to be \$1,422 million (table 1).

The research and education programs of the Department are complementary and mutually supportive in providing new knowledge, technology, and information on food, agriculture, and forestry issues vital to producers, marketing firms, consumers, and action agencies. The results of these efforts affect the total economy of the United States and millions of consumers here and abroad. Including input supply production, processing, and marketing, the agriculture and forestry sectors account for approximately 20 percent of the gross national product and employment in the United States. These sectors also provided \$11.5 billion in export trade surpluses in FY 1987. This helped to slightly offset huge trade deficits in other categories. At home, the cost of food to consumers as a share of disposable income continues to decline.

In 1987, preliminary estimates are that food required only about 12 percent of U.S. consumers' disposable income, down from 13.7 percent in 1975. At the farm level, food costs for U.S. consumers in 1987, as a percentage of disposable income, were only about 3 percent, since 75 percent of the cost of food is due to food marketing costs. In 1987, food marketing cost \$279.7 billion, up 3.6 percent from 1986. Labor costs alone for marketing, in 1987, were \$128.5 billion compared with \$94.9 billion for food at the U.S. farm level.

USDA research and education programs address national issues in production efficiency, export markets, marketing efficiency, natural resources management and conservation, human and community development, and human nutrition. Research and education programs financed by the Department, encompassing this complex array of issues, were approximately 2.0 percent of the \$56.1 billion obligated for Federal research and development in FY 1987.

The Secretary of Agriculture has identified research and extension as one of the Department's five major goals. The research and education programs provide major underpinnings for the remaining goals, which are (1) a strong, healthy agricultural economy, (2) food and fiber for peace and economic stability, (3) resource conservation, and (4) support for State and local governments.

Funding for USDA research and education programs has increased in current dollars from \$983 million in FY 1980 to \$1,422 million for FY 1988 (table 1 and fig. 1). However, the gain in current dollars for research and education was offset by inflation over the period. In constant 1980 dollars, funding was virtually the same in FY 1988 as in FY 1980 (table 2 and fig. 2).

The overall R&E funding in constant dollars over the FY 1979-87 period has tended to vary only modestly. USDA funding for research in constant dollars was highest in 1985, and next highest in 1981. Funding for education in constant dollars declined in all years except 1983 from 1980 to date (table 2 and fig. 2).

Differences in funding were apparent among the R&E agencies. Six agencies operating R&E programs over the FY 1980-88 period had funding increases more than sufficient to cover inflation, and seven did not receive increases large enough to cover inflation (table 3).¹

¹The Cooperative State Research Service received funding increases for research programs; however, the Agency did not receive large enough increases to cover inflation for its educational programs.

Table 1.

U.S. Department of Agriculture: Appropriations for research and education, FY 1980-88

Item	1980	1981	1982	1983	1984	1985	1986 ^{1/}	1987	1988
-----Million Dollars-----									
RESEARCH									
Agricultural Research Service ^{2/}	358.0	404.1	423.2	451.9	469.0	492.1	483.2	521.3	545.7
Coop. State Research Service ^{3/}									
Hatch Act formula	118.6	128.6	141.1	147.2	152.3	156.5	148.8	148.8	155.5
Cooperative Forestry	10.0	10.8	12.0	12.4	12.7	13.1	12.4	12.4	17.5
1890 Colleges & Tuskegee	17.8	19.3	21.5	21.8	22.8	23.5	22.3	22.3	23.3
Special Research Grants	15.2	18.2	23.1	27.8	26.5	32.0	29.0	55.1	50.6
Competitive Research Grants	15.5	16.0	16.3	17.0	17.0	46.0	42.3	40.7	42.4
Rural Development Research	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Animal Health & Disease	6.0	6.5	5.8	5.8	5.8	5.8	5.5	5.5	5.5
Direct Federal Admin.	1.3	1.3	0.8	0.3	0.6	1.5	1.6	2.9	4.1
Forestry Competitive Grants	0.0	0.0	0.0	0.0	0.0	7.8	6.5	6.0	3.0
Total, CSRS ^{3/}	185.9	200.7	220.6	232.3	237.7	286.2	268.4	293.7	301.9
National Ag. Statistics Svc.	5.0	7.5	7.0	7.6	8.2	8.4	8.0	3.4	3.6
Economic Research Service	26.1	39.5	39.4	38.8	44.3	47.1	44.1	44.8	48.2
Human Nutrition Info. Service	7.1	8.2	8.5	7.7	6.1	7.5	12.9	7.0	8.6
Animal & Plant Health Insp. Svc.	0.0	0.0	0.0	0.0	0.0	0.0	4.4	4.9	5.4
Agricultural Coop. Service	1.6	1.8	1.7	2.2	2.2	2.9	2.7	2.7	2.7
Agricultural Marketing Service	1.3	1.4	1.5	1.5	1.6	1.6	1.5	1.5	1.6
Office of Transportation	0.8	0.9	1.0	0.8	0.8	1.3	1.1	1.0	1.0
Office of Int. Coop. & Dev.	5.3	5.0	0.7	5.5	5.3	5.4	3.1	4.2	1.5
Forest Service	95.9	108.4	112.1	107.7	108.7	113.8	113.6	126.7	132.5
Federal Grain Inspection Service	0.5	0.5	0.6	0.6	0.7	1.1	0.9	0.8	1.0
Total, Research	687.5	778.0	816.3	856.6	884.6	967.4	943.9	1012.0	1053.7
EDUCATION									
Extension Service ^{4/}									
Smith-Lever 3(b&c) Formula	189.3	205.4	219.4	230.4	235.0	241.5	229.7	235.9	241.6
Other Extension Programs	78.2	80.7	90.0	92.8	93.8	96.8	93.1	96.8	99.4
Direct Federal Admin.	6.5	6.1	6.3	5.4	5.5	5.4	5.2	6.3	7.4
Total, Extension Service ^{4/}	274.0	292.2	315.7	328.6	334.3	343.7	328.0	339.0	348.4
Coop. State Research Service									
Bankhead-Jones	11.5	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morrill-Nelson	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.6
Competitive Fellowship Grants	0.0	0.0	0.0	0.0	5.0	5.0	2.9	2.9	2.9
1890 College Grants	0.0	0.0	0.0	0.0	0.0	2.0	1.9	1.9	1.9
Total, CSRS	14.2	14.2	2.8	2.8	7.8	9.8	7.6	7.6	7.4
National Agricultural Library	7.3	8.2	8.2	9.1	10.4	11.5	10.8	11.1	12.2
Total, Education	295.5	314.6	326.7	340.5	352.5	365.0	346.4	357.7	368.0
TOTAL, Research & Education	983.0	1092.6	1143.0	1197.1	1237.1	1332.4	1290.3	1369.7	1421.7

^{1/} Reflects reductions under P.L. 99-177, the Balanced Budget and Emergency Deficit Control Act of 1985.

^{2/} Excludes ARS construction funding, which has been (in million of dollars): \$0 ('80), \$12.1 ('81), \$8.6 ('82), \$4.9 ('83), \$77.9 ('84), \$22.4 ('85), \$6.1 ('86), \$37.4 ('87), \$57.8 ('88).

^{3/} Excludes 1890 Colleges and Tuskegee Research Facilities funding, which has been \$10.0 million annually from FY 1983 through FY 1985 and \$9.5 million each in FY '86 and FY '87 and facility funding in FY '87 of \$32.2 million.

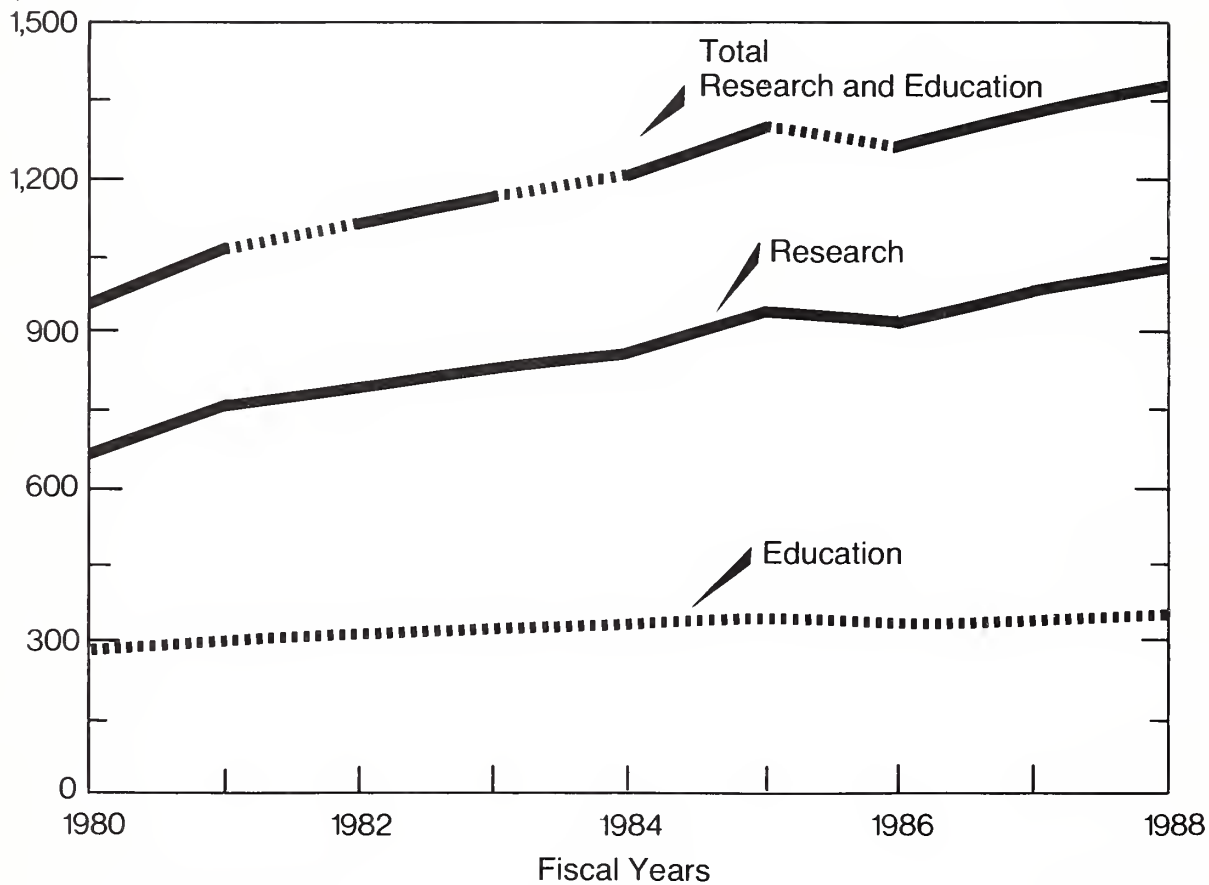
^{4/} Excludes 1890 Colleges and Tuskegee Extension Facilities funding of \$9.5 million in FY '88.

Source: Office of Budget and Program Analysis (OBPA), USDA.

Figure 1

USDA Appropriations for Research and Education Programs (Current Dollars)

\$ million



Source—OBPA, USDA

Table 2.

U.S. Department of Agriculture: Appropriations for research
and education in constant 1980 dollars, FY 1980-88

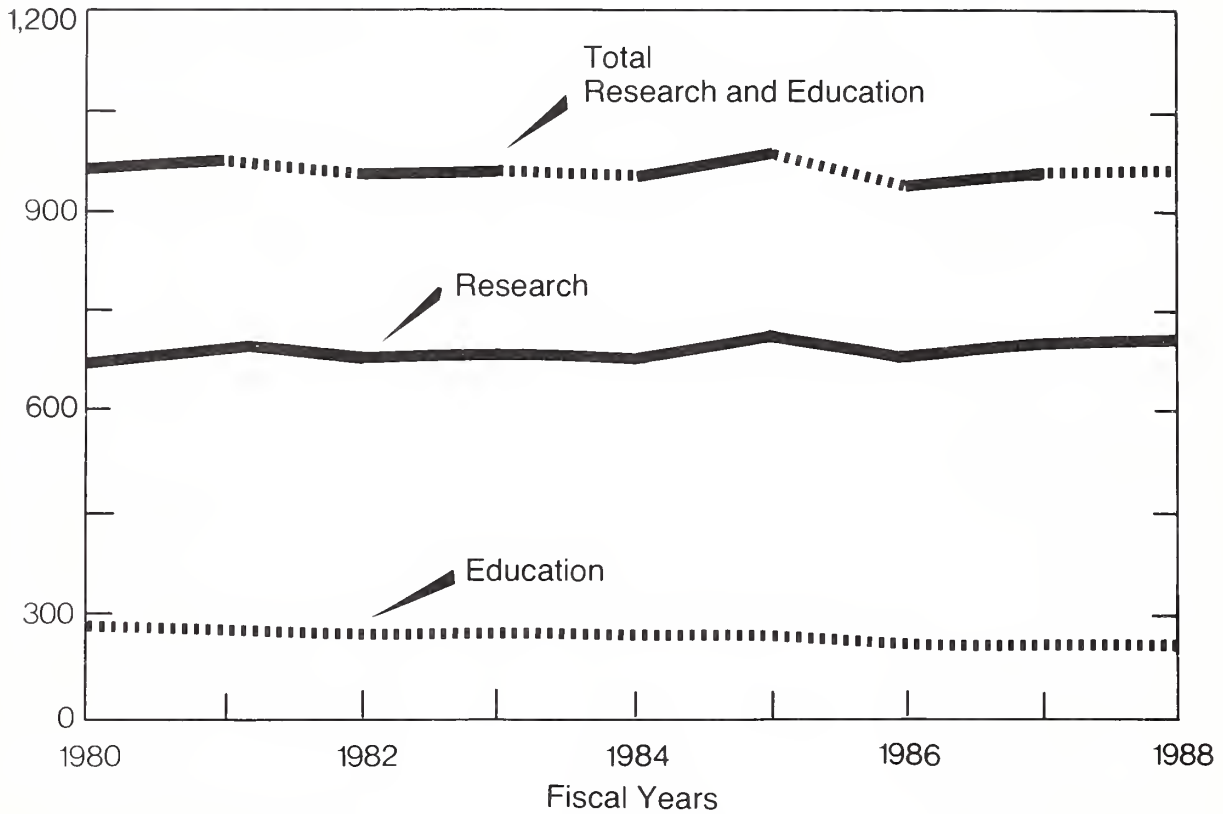
Item	1980	1981	1982	1983	1984	1985	1986	1987	1988
Inflation Rate		9.2%	7.1%	4.0%	4.4%	3.7%	2.4%	3.6%	3.5%
GNP Deflator for Gov't. Purchases Index: (1982=100)	85.5	93.4	100.0	104.0	108.6	112.6	115.3	119.5	123.7
-----Million Dollars-----									
RESEARCH									
Agricultural Research Service	358.0	369.9	361.8	371.5	369.2	373.7	358.3	373.0	377.2
Coop. State Research Service									
Hatch Act formula	118.6	117.7	120.6	121.0	119.9	118.8	110.3	106.5	107.5
Cooperative Forestry	10.0	9.9	10.3	10.2	10.0	9.9	9.2	8.9	12.1
1890 Colleges & Tuskegee	17.8	17.7	18.4	17.9	18.0	17.8	16.5	16.0	16.1
Special Research Grants	15.2	16.7	19.8	22.9	20.9	24.3	21.5	39.4	35.0
Competitive Research Grants	15.5	14.6	13.9	14.0	13.4	34.9	31.4	29.1	29.3
Rural Development Research	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Animal Health & Disease	6.0	6.0	5.0	4.8	4.6	4.4	4.1	3.9	3.8
Direct Federal Admin.	1.3	1.2	0.7	0.2	0.5	1.1	1.2	2.1	2.8
Forestry Competitive Grants	0.0	0.0	0.0	0.0	0.0	5.9	4.8	4.3	2.1
Total, CSRS	185.9	183.7	188.6	191.0	187.1	217.3	199.0	210.1	208.7
National Ag. Statistics Svc.	5.0	6.9	6.0	6.2	6.5	6.4	5.9	2.4	2.5
Economic Research Service	26.1	36.2	33.7	31.9	34.9	35.8	32.7	32.1	33.3
Human Nutrition Info. Service	7.1	7.5	7.3	6.3	4.8	5.7	9.6	5.0	5.9
Animal & Plant Health Insp. Svc.	0.0	0.0	0.0	0.0	0.0	0.0	3.3	3.5	3.7
Agricultural Coop. Service	1.6	1.6	1.5	1.8	1.7	2.2	2.0	1.9	1.9
Agricultural Marketing Service	1.3	1.3	1.3	1.2	1.3	1.2	1.1	1.1	1.1
Office of Transportation	0.8	0.8	0.9	0.7	0.6	1.0	0.8	0.7	0.7
Office of Int. Coop. & Dev.	5.3	4.6	0.6	4.5	4.2	4.1	2.3	3.0	1.0
Forest Service	95.9	99.2	95.8	88.5	85.6	86.4	84.2	90.7	91.6
Federal Grain Inspection Service	0.5	0.5	0.5	0.5	0.6	0.8	0.7	0.6	0.7
Total, Research	687.5	712.2	697.9	704.2	696.4	734.6	699.9	724.1	728.3
EDUCATION									
Extension Service									
Smith-Lever 3(b&c) Formula	189.3	188.0	187.6	189.4	185.0	183.4	170.3	168.8	167.0
Other Extension Programs	78.2	73.9	77.0	76.3	73.8	73.5	69.0	69.3	68.7
Direct Federal Admin.	6.5	5.6	5.4	4.4	4.3	4.1	3.9	4.5	5.1
Total, Extension Service	274.0	267.5	269.9	270.1	263.2	261.0	243.2	242.5	240.8
Coop. State Research Service									
Bankhead-Jones	11.5	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morrill-Nelson	2.7	2.5	2.4	2.3	2.2	2.1	2.1	2.0	1.8
Competitive Fellowship Grants	0.0	0.0	0.0	0.0	3.9	3.8	2.2	2.1	2.0
1890 Colleges Grants	0.0	0.0	0.0	0.0	0.0	1.5	1.4	1.4	1.3
Total, CSRS	14.2	13.0	2.4	2.3	6.1	7.4	5.6	5.4	5.1
National Agricultural Library	7.3	7.5	7.0	7.5	8.2	8.7	8.0	7.9	8.4
Total, Education	295.5	288.0	279.3	279.9	277.5	277.2	256.9	255.9	254.4
TOTAL, Research & Education	983.0	1000.2	977.3	984.2	974.0	1011.7	956.8	980.0	982.7

Source: OBPA, USDA

Figure 2

USDA Appropriations for Research and Education Programs (Constant Dollars)

\$ million



Source—OBPA, USDA

Table 3.

U.S. Department of Agriculture: Percent changes in appropriations for research and education programs, by Agency, from FY 1980 to 1988 in constant 1980 and current dollars

<u>Agency</u>	<u>Constant 1980 dollars</u>	<u>Current dollars</u>
<u>Research</u>	<u>Percent</u>	<u>Percent</u>
Agricultural Research Service	+5.4	+52.4
Cooperative State Research Service	+14.3	+62.4
National Agricultural Statistics Service	-50.0	-28.0
Economic Research Service	+27.6	+84.7
Human Nutrition Information Service	-16.9	+21.1
Animal and Plant Health Inspection Service	N/A	--
Agricultural Cooperative Service	+18.8	+68.8
Agricultural Marketing Service	-15.4	+18.8
Office of Transportation	-12.5	+25.0
Office of International Coop. & Dev.	-81.1	-71.7
Forest Service	-4.5	+38.2
Federal Grain Inspection Service	+40.0	+100.0
Total, research	<u>+5.9</u>	<u>+53.3</u>
<u>Education</u>		
Extension Service	-12.1	+27.2
Cooperative State Research Service	-64.1	-47.9
National Agricultural Library	<u>+15.1</u>	<u>+67.1</u>
Total, education	<u>-13.9</u>	<u>+24.5</u>
Total, research and education	0	+44.6

STATE AND COUNTY SUPPORT

State and county support for research and extension for the food, fiber, and forestry system at about \$1.7 billion per year is slightly higher than that of the Federal contribution of about \$1.4 billion. Combined Federal, State, and county funds support approximately 10,000 scientists and 15,000 extension personnel, who are the formulators and extenders of knowledge needed by the Nation's largest industry. Public investment in food and agriculture research and education has consistently provided annual returns of 30 percent or more.

State support for the food and agricultural sciences is provided primarily through the land-grant institutions (1862, 1890, forestry schools, and Tuskegee Institute) and includes funds for research, extension, and higher education. However, an estimated 50 State-supported, non-land-grant institutions also have agricultural programs. These programs are primarily devoted to higher education.

PRIVATE INDUSTRY RESEARCH AND DEVELOPMENT

The report "A Survey of U.S. Agricultural Research by Private Industry III," published in July 1985 by the Agricultural Research Institute (ARI) of Bethesda, MD, stated that "the best estimate of private industry annual expenditures in agricultural research (is) approximately 2.1 billion dollars."

Based on ARI data, industry overall is apparently devoting approximately 15 percent of its research and development expenditures to basic research, 43.5 percent to applied research, and 41.5 percent to developmental research. However, 62 percent of the companies responding to an ARI survey reported doing no basic research, and 36.5 percent reported doing no research of any kind.

Major areas of research conducted by industry, as reported by ARI, are in pesticides, plant breeding, and human food. These three areas accounted for nearly two-thirds of the agricultural research carried on by industry.

SELECTED SIGNIFICANT ACTIVITIES AND ACCOMPLISHMENTS
IN THE FOOD AND AGRICULTURAL SCIENCES

AGRICULTURAL RESEARCH SERVICE

The Agricultural Research Service (ARS) conducts mission-oriented research to ensure a continuing abundance of high-quality, nutritious, reasonably priced food and other agricultural products to meet domestic and world needs while maintaining environmental quality. ARS uses coordinated, interdisciplinary approaches to conduct basic and applied research pertaining to soil and water conservation, plant sciences, animal sciences, commodity conversion and delivery, human nutrition, and integration of agricultural systems.

Research is conducted at numerous locations in the United States, and in Puerto Rico, the Virgin Islands, and several foreign countries. When appropriate, the research is conducted in cooperation with the State agricultural experiment stations, other State and Federal agencies, and private institutions.

Farm Bill
Compliance Aided

Better erosion prediction will assist implementation of the compliance provisions of the 1985 Farm Bill. A comprehensive modification of the Universal Soil Loss Equation (USLE) for the Dryfarmed Grain Region of the Pacific Northwest has been developed by ARS scientists. This most recent change in the USLE will significantly improve erosion prediction under the severe erosive conditions caused by rain and snowmelt on thawing soil in that region. A better procedure for estimating erosion in the Pacific Northwest has been a pressing need of the Soil Conservation Service for some time.

Patent Licenses
Offer Industry
Firms Opportunities
To Profit

Fourteen royalty-bearing patent licenses were granted industry firms in FY 1987. These licenses were granted through the National Technical Information Service. In addition, ARS granted nine non-royalty-bearing licenses directly to industry firms. All licenses allow industry firms the opportunity to develop potentially profitable commercial products or processes based on ARS patents.

Better Crops, Safer
Water With Drip
Irrigation

In irrigated areas, deep percolation of excess irrigation water can pollute streams and groundwater with salts and potentially toxic elements and chemicals leached below the root zone. A subsurface drip irrigation system installed 4 years ago in the San Joaquin Valley of California has been used to irrigate and fertilize tomato, broccoli, cotton, and cantaloupe without allowing drainage. Evaporative losses of water from the soil surface were nearly eliminated, and tomato yields of 100 tons/acre were produced in 1987. Subsurface installation of the drip system also eliminated the nonuniformity of infiltration, thereby improving application efficiency and uniformity of water and nutrient distribution in the root zone.

Input Costs Reduced
20 to 40 Percent
on Irrigated Land

Numerous field studies over 3 years have shown that conservation tillage, including no-tillage and reduced tillage, can be practiced successfully on furrow-irrigated land without yield loss and with 20 to 40 percent lower input costs. No-tillage can be used for some cropping sequences, and when used, reduces furrow erosion 80 to 100 percent compared to conventional tillage. Reduced tillage can be used for the remainder of the rotation cycle, reducing erosion 60 to 90 percent.

Cotton Growers Use
Less Insecticide,
Improve Profits \$77
Per Acre

Cotton growers in the Carolinas have cut insecticide use by 60 to 70 percent and are making about \$77 more per acre because of a joint USDA/State/grower boll weevil eradication program. The principal strategy, based on research by ARS and implemented by the Animal and Plant Health Inspection Service, is to use timed malathion sprays for two seasons and specially developed traps to catch stray weevils and monitor their movement. This eradication program has boosted cotton production and added many millions of dollars in profits for participating States. The eradication strategies will next be undertaken on 375,000 acres of cotton in Georgia, Alabama, and north Florida.

First Corn With
Higher Rates of
Photosynthesis

Lines of corn with consistently high rates of photosynthesis and, as a direct result, higher yields have been bred successfully for the first time. Photosynthesis is the photochemical process by which green plants manufacture food. As world population and food demands grow, increasing the efficiency of photosynthesis poses an exciting challenge. More efficient crop plants also decrease unit costs of production for the farmer. Further research is in progress to determine just how much yield has been increased by this experimental technique and how commercial seed breeders can best utilize this information to develop higher yielding varieties.

New Potato Produces
a Better, Lower Fat
Chip

The Atlantic potato, an ARS-developed variety, makes chips with lower fat content than any other variety. After only 5 years of large-scale production, Atlantic is the third most popular chipping potato in North America. Usually when potato chips are deep-fried, fat replaces the water in raw chips. Atlantic chips, however, absorb less fat than other varieties because Atlantic has a lower ratio of water to solid tissue. Potato chip makers prefer Atlantic because they get more chips per pound from varieties with a high proportion of solid tissue.

Export of Unshelled
Walnuts to Japan
Made Possible

In 1986, Japan approved entry of unshelled U.S. walnuts for the first time. Import of unshelled walnuts had been prohibited because of the codling moth. A safe treatment process utilizing methyl bromide under reduced pressure was developed by ARS and eventually approved by Japan. Since Japan lifted the ban, the

U.S. exported 3,422 tons of unshelled walnuts valued at \$6.8 million from August 1, 1986, until July 31, 1987. The walnut industry expects to ship about 10,000 tons per annum with a value of about \$20 million.

Potential Apple
Exports to Japan
Enhanced

A two-step treatment can now rid apples of the pesky codling moth without damaging fruit quality. Cold storage kills the eggs, and fumigation with low levels of methyl bromide kills the larvae. When these treatments are approved by Japan, western U.S. apple growers will be able to net millions of dollars exporting apples there. Fruit known to host the codling moth has been banned, except for treated cherries and walnuts, because codling moths are not found in Japan.

Insect Genetic
Sterility Offers
New Way To Control
Pests

Female insects that sterilize their sons--and produce daughters that do the same--have been bred for the first time. By crossing tobacco budworms with a related species, ARS scientists developed hybrids that pass along a trait for male sterility. The trait could mean genetic control of a pest that devours millions of dollars worth of cotton, tobacco, and vegetables a year. Further, the budworm is also becoming resistant to the chemicals that best control it, the pyrethroids. In a test on St. Croix in the U.S. Virgin Islands, this technique reduced a natural insect population by 75 percent. The scientists are seeking the same kind of sterility in the cotton bollworm--a closely related and even more serious crop pest.

Combination
Biological and
Chemical Treatment
Kills All Velvet
Leaf

Soybean and corn growers will benefit from new ARS weed control research. In laboratory tests, the fungus Fusarium lateritium killed about 25 percent of velvet leaf, one of the most serious broadleaf weeds, while the chemical 2,4-DB killed 50 to 60 percent. Together they could have controlled the weed in soybeans and corn except for one problem: the chemical killed the fungus. But now scientists have found that applying 2,4-DB first and then the fungus--even just seconds later--gives 100 percent weed control. Scientists are developing a sprayer that will disperse the fungus from one end and 2,4-DB from the other.

Biotechnology Aids
in Fight Against
Pseudorabies in
Swine

One of the greatest stumbling blocks to the control and eradication of pseudorabies is the ability of the virus to go into a latency stage, which allows it to persist undetected in the pig. Using recombinant DNA technology, ARS researchers have identified and are sequencing immediate early genes that may be responsible for latency. This information is being used to investigate methods to force the virus out of latency or to prepare virus strains incapable of going into latency. The ARS research program on pseudorabies has been closely coordinated with the control and eradication efforts of the Animal and Plant Health Inspection Service and the swine industry.

Vaccine To Protect Turkeys Licensed to Industry	The first federally licensed vaccine against hemorrhagic enteritis was developed and patented by ARS scientists. Nine firms have obtained licenses to produce and market this vaccine. Hemorrhagic enteritis, one of the most prevalent diseases of the turkey's immune system, may kill 20 percent of a producer's young turkeys. Use of this vaccine can lower the cost of production and could lead to lower prices for consumers.
Rapid Test Improves Export Potential for Cattle	The inability to differentiate between bluetongue and epizootic hemorrhagic disease (EHD) has affected the export of cattle. Monoclonal antibodies developed by ARS scientists now allow a quick and accurate differentiation between these two diseases. EHD does not kill livestock, but when confused with the bluetongue virus, it prevents export of cattle from the United States to bluetongue-free locations.
Chemical Prevents Aflatoxin Poisoning in Chickens	Chicken feed is often contaminated with aflatoxin, resulting in reduced gains, fewer eggs, lower resistance to disease, and sometimes death. ARS scientists, in collaboration with researchers from Texas A&M University, have found that hydrated sodium calcium aluminosilicate, a common feed additive used to keep feed from clumping, may solve this problem. The silicate additive in the feed apparently binds the aflatoxin, and it passes through the intestinal tract of the chicken without causing illness.
New Alternative to Sulfite Use on Produce	Enzymatic browning, the discoloration that occurs in fresh fruits and vegetables when they are peeled, sliced, or crushed, is a major problem in the produce industry. Sulfites are the best known inhibitors of this browning, but the Food and Drug Administration has banned their use on fresh fruits and vegetables. Alternative compounds, derivatives of vitamin C (ascorbic acid) and starch, were found most effective. These compounds significantly reduced the amount of browning on apple products. When they were used in combination or with cinnamic acid, citric acid, or polyphosphates, they stopped the browning about as well as sulfites. These treatments could be the basis for expanded marketing of lightly processed produce.
Backfat Not Needed for Tender Beef	Backfat cover is unrelated to beef carcass tenderness. Backfat (subcutaneous fat) cover is thought to act as an insulator, thereby preventing cold-induced meat toughness. However, ARS research has determined that there is no conclusive evidence that cold-shortening (cold-induced toughness) actually happens under current meat industry practices of slaughtering and handling of carcasses.
Test for <u>Listeria</u> Enhances Food Safety	The bacterium <u>Listeria monocytogenes</u> has been recently implicated as a cause of fatal disease outbreaks traced to contaminated foods. There is a critical need to assess the

incidence of the microorganism in food products; however, assessment has been hampered in part by the lack of a method for easily identifying the organism. ARS scientists have now developed a highly specific growth medium upon which the bacterium develops a characteristic black color. This new method should greatly enhance the ability of industry and the Food Safety and Inspection Service to inspect foods for the presence of this microorganism.

New Cotton/Glass
Fabric for
Industrial Use

Despite the many advantages of cotton, its use for industrial fabrics has declined, largely because high-strength requirements cause the cotton fabrics to be too heavy. One approach to improving strength of the cotton fabrics is by reinforcing them with high-tenacity, manmade fibers. A process was developed and patented whereby cotton yarns with glass filament cores were produced. Fabrics woven from the cotton/glass core yarns were much stronger and had better flammability resistance than comparable all-cotton fabrics. Two major textile companies have applied for a license to produce the cotton/glass core-yarn fabric.

Hay Preservative
Applied During
Baling Improves
Quality

A device developed by ARS that injects anhydrous ammonia and other liquid preservatives into hay while it is being baled improves forage quality. A syringe, powered by a tractor's hydraulic system, draws liquid preservatives from a tank mounted on the back of a baler and injects precise amounts into the bale. The new process will improve forage quality and the efficiency of dairy production units.

Kenaf Shows
Potential as
Industrial Crop

A commercial mill for processing the fast-growing plant kenaf into pulp for papermaking is expected to be operational by mid-1990 in Texas. As part of a \$1.4 million Kenaf Demonstration Project involving USDA and commercial groups, 83,000 copies of the Bakersfield Californian newspaper were printed on kenaf paper in July 1987, showing that it can compete with paper from wood pulp in production costs and quality. In the 1960's and 1970's, ARS research demonstrated the technical feasibility of making paper from kenaf. High marks were given to the plant as a potential pulp source to help supply the newsprint used in the United States, most of which is imported. The annual cost of newsprint in the United States is \$7.5 billion. Kenaf could be grown in many parts of the country as an alternative crop.

Boron in Fruits and
Vegetables May
Reduce Osteoporosis

Based on findings in studies with animal models showing that the trace mineral boron is involved in bone calcification and mineral metabolism, a followup study was conducted at the ARS Grand Forks Human Nutrition Research Center with postmenopausal women. They were fed a low-boron diet made up of conventional foods but low in fruits and vegetables.

When boron was added to the diet after 119 days, the serum estrogen (estradiol 17 beta) concentration increased twofold to normal levels, and losses of calcium, phosphorus, and magnesium decreased markedly. These findings suggest that boron affects retention of bone minerals and that ample boron supplied by fruits and vegetables may help reduce the risk of osteoporosis.

Cause of Infant
Food Intolerance
Identified

An epidemiologic study at the ARS Children's Nutrition Research Center showed that malnutrition is a primary factor leading to severe formula intolerance. Lactoferrin, a protein, was identified as the major protective component in human milk that spares breast-fed infants from food intolerance. Lactoferrin is known to help infants absorb iron from mothers' milk and to protect infants against intestinal infection. Results indicate that lactoferrin also stimulates growth and maturation of the gastrointestinal tract of the newborn.

Eating Legumes
(Beans, Peas, etc.)
May Reduce Risk
of Diabetes

Long-term consumption of foods high in amylose (beans, peas, and other legumes) may lower the risk of developing diabetes and related disorders. Of the two components of starch, amylose and amylopectin, amylose has been found to improve the utilization of glucose and reduce the need for insulin in human subjects. In addition, certain blood fats associated with the risk of coronary heart disease also are decreased. This effect is presumed to be due to the slower rate of digestion and absorption of amylose compared with that of amylopectin.

Early Identification
of Heart Disease
Risk Is Possible

Scientists at the ARS Human Nutrition Research Center on Aging have discovered a specific APO A-1 gene polymorphism associated with a high density lipoprotein (HDL) deficiency, a condition commonly observed in individuals with coronary artery disease (CAD). APO A-1 is the major protein in HDL. This gene deficit was found in only 4 percent of normal persons while 32 percent of CAD patients and 66 percent of individuals with genetic HDL deficiency carried this genetic marker. This finding may permit the early identification of individuals at increased risk for CAD so that appropriate risk factor modifications can be recommended to prevent this disorder.

Expert System
Provides Answers
for Peanut Growers

Irrigating and controlling pests in peanuts are very complex because of the deep rooting characteristics and underground indeterminate fruiting habit of the peanut plant, the competition of pests above and below ground, and the primary concerns for edible peanut quality. New concepts and an extensive knowledge base developed from field experiments have been used to develop an expert system to manage peanut production. The system provides decisions on when and how much to irrigate for control of pod zone temperature. The system is being validated by several cooperative farmers and the Extension Service, with excellent results. This system will save farmers

millions of dollars each year by providing higher yields and better quality peanuts at reduced production costs.

Dairy Farm Computer
Model Compares
Alternative
Technologies

A simulation model can provide an excellent tool for evaluating and comparing alternative technology and management strategy for agricultural production. Recent progress was made on a whole-farm model of the dairy farm called DAFOSYM, which greatly improves the model's ability to evaluate forage quality. New submodels incorporated into the whole-farm model include models of field curing alfalfa, hay storage, silo storage, and animal utilization. The revised model is being used to study the economic benefit of a new forage-harvesting process that macerates forage and presses it into a mat for rapid field curing. A preliminary analysis shows that the new process is cost effective and that the improvement in forage quality could provide a substantial economic saving to the farmer.

Expert System To
Aid Farm Management
and Conserve
Resources

An expert system has been developed and is being tested that aids a producer in choosing the conservation tillage system, or practice, that will give maximum crop yield. The production manager can use a small personal computer and answer questions about soil types, management techniques, farm location, etc. The goal is to develop an integrated set of expert systems for on-farm management decisions related to production, economics, and conservation of natural resources. The research is cooperative with private industries and universities as part of an ARS project EXTRA, Expert Systems for Technology and Resource-Conservation in Agriculture.

PASTURE Computer
Model Aids Small
Farms

To help farmers manage their pastures, ARS scientists, cooperating with the University of Kentucky, have devised a plant growth model to be incorporated into an expert system for small farms. PASTURE, when told how much a specific piece of land will be fertilized, irrigated, and grazed, calculates how much dry matter (and of what quality) will be produced. The computer model has been validated and works for bermudagrass and fescue; it will be adapted to about 17 other types of forages, including clovers. Extension Service personnel can use this model to assist small farmers in developing management programs to maximize forage production.

Industry Firms
Benefit From
Technology Transfer
Via Computer

In the past year, several hundred private-industry firms have been granted direct access to the latest ARS technology via a telecommunications link with TEKTRAN, a computer data base containing over 8,000 brief, easy-to-read summaries of recent research reports. More than 300 new reports added each month offer firms prepublication notice of ARS findings.

COOPERATIVE STATE RESEARCH SERVICE

The mission of the Cooperative State Research Service (CSRS) is to advance science and technology in support of agriculture, forestry, people, and communities in partnership with the State agricultural experiment station system, colleges, universities, and other research organizations, and in consonance with the Secretary of Agriculture and the intent of Congress. CSRS scientists work with regional and national groups to assure the quality of science and to set research priorities. The agency administers USDA research funds appropriated by Congress for the States, gives focus to the broad programs of agricultural research in the States, and participates in a nationwide system of research planning and coordination.

State Cooperators

The programs of CSRS are carried out cooperatively with:

- o 59 State and territorial agricultural experiment stations;
- o 17 colleges of 1890, including Tuskegee University;
- o 28 schools of forestry; and
- o 29 colleges of veterinary medicine.

Most of these institutions are associated with the land-grant universities. When all publicly supported agricultural research is taken into account, including all research agencies within the U.S. Department of Agriculture, two-thirds of the full-time equivalent scientist years are found in the State agricultural experiment station system. Because of shared responsibilities between research and teaching in the universities, the actual number of scientists is far larger. This provides a wide range of talent capable of addressing most kinds of problems faced by agriculture.

Hatch Act Centennial

A celebration of the 100th anniversary of the signing of the Hatch Act of 1887, which created the State agricultural experiment stations, was held during 1987 by CSRS and various agricultural experiment stations around the country. The yearlong activities were kicked off with a national forum entitled "Research--Tomorrow's Challenges," held in Washington, DC, March 2-3, 1987. A highlight of this forum was the presentation of the William Henry Hatch Centennial Year Lecture, "Plant Hormone Research--A Continuing Challenge." "The Search for Life," the new Smithsonian Institution exhibit commemorating the Hatch Act and American agriculture, was previewed and opened to the public. Other highlights of the forum were the release of a history book of the State agricultural experiment stations, a video and film production entitled "New Beginnings," and a

slide tape set entitled "SAES: Catalyst for American Agriculture." Observances at the State agricultural experiment stations were many and varied, including numerous receptions and banquets, publication of special annual reports, symposia and exhibits, seminars and workshops, proclamations signed by Governors of States, and tours of laboratories and research facilities. A national tribute to William Henry Hatch, author of the Hatch Act of 1887, was held in Hanibal, MO, Mr. Hatch's hometown. A plaque commemorating the event was affixed to a statue of Mr. Hatch.

Hybrid Striped Bass

A field trial project for raising hybrid striped bass (HSB) in farm ponds began operation in October 1987 at Walnut Point in Chestertown, MD. The HSB is a cross between the female striped bass (Morone saxatilis) and the male white bass (M. chrysops). While distinguishable to the trained eye, the HSB has the flavor and appearance of a striped bass but is more disease resistant and grows faster than either culture. First cultured in South Carolina by Robert Stevens of the U.S. Fish and Wildlife Service in 1965, the HSB was used to stock numerous freshwater lakes, and a strong sport fishery developed from these efforts. Maryland Department of Natural Resources stocked the HSB in several freshwater impoundments and in tributaries to the Chesapeake Bay, but this practice was recently halted because of fears that the introduced fish would interbreed with native striped bass. Now the HSB culture techniques originally developed to enhance sport fishing have been successfully applied in experimental trials for commercial aquaculture. The fish will be grown to 4- to 6-inch fingerlings during the first season, overwintered, and stocked into the large production ponds in the beginning of the second season. By late summer or early fall of the second year, they will reach market size. The 6-year aquaculture project involves 24 underwater acres and is expected to produce at least 60,000 pounds of fish per year. At current market prices, this could mean from \$210,000 to \$300,000 in gross annual revenues.

Kenaf Production

Kenaf newsprint was tested and commercialized. Kenaf is a nonwood fiber crop that will grow from seedling to 10 feet in less than 3 months and can be transformed from seedling to newsprint in less than 6 months. Newsprint is normally made from wood such as northern spruce and southern pine. A kenaf pressrun at The Bakersfield Californian culminated a 17-month joint effort by USDA and Kenaf International. The paper's pressrun of 83,000 consumed 12 tons of kenaf paper. The Bakersfield test run received highest praise by newspaper production experts for its brightness, strength, smooth ink laydown, reduced ink ruboff, and crisp color reproduction. The Kenaf International and Canadian International Paper, Inc., have agreed to a joint venture for the production of paper and

related pulp and paper products at a mill in southern Texas, which is scheduled to begin operation next year.

Regional Aquaculture Centers

Four regional aquaculture centers have been designated to administer research, education, and extension efforts for the development of aquaculture resources unique to each region. The centers are administered through The Tropical Aquaculture Center, Oceanic Institute and the University of Hawaii, Waimanalo, HI; The Northeastern Regional Aquaculture Center, Southeastern Massachusetts University, North Dartmouth, MA; The Southern Regional Aquaculture Center, Agricultural Experiment Station, Mississippi State University, Mississippi State, MS; and The Western Regional Aquaculture Center, University of Washington, Seattle, WA.

Accomplishments of the State agricultural experiment station System were many and varied. Some examples are described in the following paragraphs.

Fluidized-Bed Combuster

Researchers at the Ohio Agricultural Research and Development Center have designed an automated home furnace that is inexpensive, clean burning, and potentially useful for providing a little relief from the Nation's overwhelming grain surplus. Called a fluidized-bed combuster, the furnace burns corncobs and other waste. In this type of furnace, a bed of very hot sand is kept in a fluid state by blowing a stream of air through it. In such an oxygen-enriched state, any fuel poured onto the hot sand (900°F) burns so completely that there is almost no pollution. Ash passes out of the burner with the combustion air and is collected. The ash is sometimes used as a valued fertilizer, depending on the fuel used. The burning fuel maintains and increases the sand temperature and also produces enough excess heat to warm homes, buildings, and domestic water. Through the addition of a turbine, the burning fuel can generate electricity. The sand is initially brought up to temperature with an oil or gas flame. Researchers involved in the study say 11.8 pounds of ground corncobs has the heating capacity of 1 gallon of propane. That means the furnace could heat a contemporary three-bedroom home in an Ohio-type climate for a year on corncobs from about 10 acres of corn. Shelled corn has also tested out as an almost ideal fuel. According to the researchers, 1 bushel of corn has the same gross heat energy as 4.2 gallons of propane. The furnace can also be readily adapted to burn coal or wood pellets.

Turkey Semen Enzyme

Researchers at Clemson University have discovered an enzyme in turkey semen that may prove useful in treating blood clots in humans. Scientists isolated the enzyme while studying factors that affect the longevity of turkey semen, a subject of concern to the turkey industry. This is the first time the enzyme has

been isolated. The enzyme must first be classified and then it will be examined for its usefulness in other fields. If the substance proves useful in dissolving blood clots, it could provide a method for treating thromboses such as those that cause heart attacks. The method would be more precise and less expensive than the current method of using enzymes produced from bacteria. By engineering the substance to attack specific proteins in milks or other foods, scientists may also be able to utilize it to counteract allergies to certain proteins in foods.

Butter With Low Saturated Fatty Acids

Agricultural researchers at South Dakota State University have discovered that you can produce butter, milk, and other dairy products that are lower in saturated fatty acids. The fatty acid problem is reduced by feeding dairy cows a ration that substitutes sunflower seeds for 20 percent of the corn and soybean meal in the concentrate. The scientists have also determined that butter high in unsaturated fatty acids is as soft as margarine just as it comes from the refrigerator and is much softer than regular refrigerated butter. A panel of experienced flavor judges concluded that sunflower butter is equal to or superior in flavor to regular butter and that this desirable flavor is maintained after several months of normal storage. Two different kinds of sunflower seeds were used in the research with favorable results. It is not known if milk high in unsaturated fat can be produced by feeding other types of oil seed crops.

Plant Disease Data Base

Using microcomputers, a data base is being constructed at the University of Arizona to store plant disease observations for Arizona. This will facilitate addressing questions such as, What do we know about bacterial diseases of the tomato in Cochise County? Disease observations come from a variety of sources, including Extension Service specialists, diagnostic clinics, and Extension agents throughout Arizona. Many types of information are collected, including plant species, diseases observed, contributing stress factors, geographic location, observation date, estimates of disease severity, irrigation, and other cultural practices. Additional information from founding faculty members is also included in the data base. Currently, the data base holds 5,600 disease observations. When the disease incidence data base is fully operational, it will be available via modem access to anyone with a microcomputer. As more information is added to this system, researchers will be able to explain the temporal patterns of disease occurrence in the State. When combined with weather data, it improves the possibility of predicting outbreaks of diseases in crops.

Wild Potatoes to Domestic Ones

Researchers at the University of Wisconsin have found special pollen in wild potatoes that may help transfer the desirable traits of wild potatoes to domestic potatoes. This would be

done using intermediary potatoes to capture and preserve desirable genetic traits found in individual wild potatoes. The researchers perpetuate desirable characteristics of wild potatoes and screen the hybrid species for the special pollen that is compatible with domestic potatoes. The pollen is used to crossbreed the hybrid species with domestic potatoes.

NATIONAL AGRICULTURAL STATISTICS SERVICE

The National Agricultural Statistics Service (NASS) conducts research to improve the statistical methods and techniques used to produce agricultural statistics. This research is done in support of the NASS long-range program for improving the accuracy of crop and livestock estimates at minimum cost and is directed toward better sampling, yield forecasting, survey techniques, and quality assurance procedures. Some highlights of research accomplished in FY 1987 follow.

Exploratory Analysis of Hog Data

Currently, NASS staff calculates four estimators for each hog survey category with data obtained during the June mid-year surveys. To more effectively utilize current survey data, research on composite estimation (a means of statistically averaging survey estimates) was undertaken. These analyses compared six different methods of compositing the four estimators. The analysis determined the best performing composite estimator as verified by official statistics.

Objective Yield Research and Analysis

Development of an alternative estimator for the Corn Objective Yield Survey using new surface area and volume measurements of the corn ear was continued. Data were collected during 1986 and 1987 in Michigan. Results from the analysis of the 1986 data indicate that more precise estimates are possible through use of the proposed surface area and volume measurements. Analysis of the additional data collected during 1987 will further test these results.

Evaluation of an improved early forecast model for corn ear weight using daily weather data was continued in 1987 with pilot testing in Iowa and Indiana. The emphasis during these tests was on determining if weather variables could be obtained in time to produce an August 1 forecast. Results of these tests indicated that the proposed methods make more precise estimates for the August 1 forecast. Further evaluation for a four-State area is being planned for 1988.

A regression model using ear counts and ear lengths for corn production was evaluated. During the period 1980-85, the model showed evidence of outperforming current objective yield procedures for both August and September. A staff report detailing the results of this analysis is now under review.

Statistical methodology studies produced recommendations to use nested error regression models for forecast model development and to further explore between-crop yield correlations for possible improvements in survey design.

Emphasis also continues in the area of quality assessment. Data collection for narrow-row soybeans has been changed to incorporate bias-reducing methodology indicated in recent research. Recommendations for developing and using control and assurance information on the statistical process have been prepared for management review.

Robust Estimation
Research

An examination of robust estimation methods (less sensitive to outlier reports than conventional techniques) started during FY 1987 with the sending of a hog and pig data set to Oregon State University. Exploratory analysis of candidate robust estimators (for identifying and adjusting for outliers) has begun.

Farm Costs and
Return Survey
Research

On the Farm Costs and Returns Survey (FCRS), more than 500 questions are currently collected for each farmer in the sample. Each interview is lengthy. The University of Georgia has been provided 2 years of data to develop reduced set questionnaires. These shorter questionnaires could provide information about a larger number of farms so that the precision of current estimates would be improved and the respondent's burden reduced. Computer programs to analyze the relationships among the questions were under development during FY 1987.

In addition, research has been undertaken to evaluate the use of organized farm record-keeping systems in FCRS data collection in order to enhance the quality of the data and also ease the respondent's burden. The initial pilot study will provide basic information about record-keeping systems: their organization, their differences and similarities, their utilization by farm operators, and factors that characterize their users. Results will provide a foundation on which to base possible reconsideration of the FCRS survey design and data collection methods.

Questionnaire Design

A cooperative research agreement was initiated with the Survey Research Center at the University of Michigan to review and recommend changes to the Quarterly Agricultural Survey (QAS) questionnaires. Specifically, the review is intended to result in recommended changes in the questionnaire design to reduce or eliminate measurement error. A secondary expectation of the research is the development of versions of the questionnaire that are specific to the mode of data collection.

Computer-Assisted
Telephone
Interviewing

Software for computer-assisted telephone interviewing (CATI) was written to support a research study dealing with the evaluation of an alternative CATI instrument (computer version of a paper questionnaire) for the Agricultural Survey Program. This instrument uses information from prior survey data and allows the order in which questions are asked to be altered, depending on the respondent's answers. If successful, this may shorten

the length of the CATI interview, reducing enumerator and respondent fatigue.

Reinterview
Research

Reinterview research was initiated in three States in preparation for the December 1987 Agricultural Survey. This research is aimed at developing statistical quality-assurance procedures. Reinterviews allow measures to be made of variance and bias in responses and, in general, help to identify where and why errors are occurring in this Agricultural Survey Program.

Computer-Assisted
Development Research
On Area-Sampling
Frames

In this pilot research effort, digital satellite and digital map data are being used in concert to produce an area-sampling frame for three counties in Missouri. The goal is to have analysts use the computer display system, along with sophisticated image-processing algorithms and quantitative classifying and sampling methods, to produce more efficient and/or accurate area-sampling frames. If the pilot research is successful, the research effort will be expanded to larger areas. The use of geographic information-system interfaces can make better use of additional geographic and survey information. This is a cooperative research effort with the NASA-Ames Research Center.

Research To Develop
Methodology for
Using Satellite
Data

In 1987, Landsat 4 and 5 multispectral scanner data were used with NASS ground-collected data to calculate improved crop area estimates at the State and county levels in Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Missouri, and Oklahoma. Data obtained from Landsat 4 and 5 in 1987 were mostly cloud free in the major producing agricultural areas.

Scope and Effect
of Imputation
in Quarterly
Agricultural Surveys

A report documented the current data imputation (statistical adjustments for nonresponse) procedures for the Quarterly Agricultural Survey (QAS). The report covered the development of imputation and also quantified its effect on the survey expansions from the December 1986 and June 1987 surveys. The quarterly surveys have thoroughly tested the procedures, with nonresponse typically ranging between 15 and 25 percent.

ECONOMIC RESEARCH SERVICE

The Economic Research Service (ERS) produces economic and other social science information as a service to the general public and to help Congress and the Administration develop, administer, and evaluate agricultural and rural policies and programs. ERS monitors, analyzes, and forecasts U.S. and world agricultural production and demand for production resources, agricultural commodities, and food and fiber products. ERS also measures the costs of and returns to agricultural production and marketing; evaluates the economic performance of U.S. agricultural production and marketing; and estimates the effects of Government policies and programs on farmers, rural residents and communities, natural resources, and Americans in general. In addition, ERS produces economic and other social science information about the organization and institutions of the United States and world agricultural production and marketing systems, natural resources, and rural communities.

ERS-produced information is made widely available to the general public through research monographs, situation and outlook reports, professional and trade journals (including ERS's journal, The Journal of Agricultural Economics Research), magazines (including the ERS magazines, Agricultural Outlook, Farmline, National Food Review, and Rural Development Perspectives), radio, television, newspapers, direct computer access, and frequent participation of ERS staff at various public forums.

bST Significant to Dairy Industry

According to an ERS study, the use of bovine somatotropin (bST) should reinforce but not fundamentally change the current trends in the dairy industry. Cows produce more milk at less cost when injected with bST, a natural protein in cattle. However, synthetic bST can be produced at attractive prices, and dairy farmers who use it will realize significantly higher returns. If support programs allow prices to drop enough to balance production and commercial use, the bST-induced savings will be offset. But high supports would cause much larger Government outlays and surpluses.

U.S. Export Demand Monitored

ERS continuously evaluates prospects for U.S. farm export. In recent work, ERS found that export earnings and credit are the keys of Africa's food imports; for the Middle East and North Africa, plunging petroleum export earnings are important; several factors indicate that the Soviet Union's import level of the 1970's will not be repeated soon; and Japan offers potential for U.S. agricultural suppliers, although import barriers and heavy competition will limit sales.

Land Price Decline Slowed	An ERS survey revealed that farmland values were 8 percent lower in February 1987 than a year earlier, following 12-percent annual decreases in the previous 2 years. Values have dropped a third from the 1982 peak, and in some States the loss has been 50 percent. Since February, values have stabilized, and a stronger market for land is expected because of lower farm production expenses, interest expenses, and debt, coupled with higher Government commodity payments and the Conservation Reserve Program.
Rural Development Strategies Identified	ERS cosponsored a national symposium on rural entrepreneurship as a development strategy and identified specific approaches that communities can adopt. Findings were publicized in speeches, articles, and an hour-long ERS television documentary, "Your Home Town."
Farm Debt Measured	ERS's Farm Costs and Returns Survey revealed that in 1986, 12.9 percent of farms with sales over \$40,000 lost money and had relatively high debt in relation to farm assets. These units owed more than one-third of all farm debt. ERS researchers estimated that about 100,000 commercial-sized farms may default on loans in 1987.
Trade Liberalization Policies Reviewed	ERS researchers found that agricultural policies and programs supporting producers in the European Community, Japan, and the United States affect world markets the most. Economic gains from removing such support would be moderate; however, gains would be larger if developing countries were included.
Agricultural Trade Issues Analyzed	An ERS study underscores the importance of reaching beyond tariffs, quotas, and levies in the next round of multilateral trade negotiations and focusing on domestic agricultural policies as distorters of world markets.
World Economy and Trade Tracked	An ERS study found that high interest rates, declining commodity prices, and currency devaluations have thrust the greatest burden of the world economic problems onto the developing countries. Many have reduced imports to cope with repayment difficulties, hurting U.S. agricultural trade. Limited domestic industrial investment, leading to a fall in capital stock and future economic growth in many developing countries, will curtail world agricultural trade and U.S. farm exports.
Effects of Tax Reform Act on Farming Measured	ERS economists determined that the Tax Reform Act of 1986 will slightly lower farmers' tax liabilities as reduced rates and increased personal exemptions offset the loss of capital gains exclusions and investment tax credits. However, the combination of no investment credit and a longer recovery period for most farm assets will increase the cost of capital up to 10 percent.

Investment in depreciable farm capital may fall \$300 million annually.

National Rural
Policies Analyzed

ERS analysts have found that commodity prices tend to slip when monetary and fiscal policies raise farmers' interest payments. ERS analysts also determined that macroeconomic policy has a greater impact on employment in nonmetropolitan areas than in metropolitan areas.

Farm Legislation
Affecting Market
Sector

ERS researchers estimated the effects of farm legislation on firms that buy and sell farm products. Linkages between the farmer and the consumer are more economically important to farmers than those between farmers and suppliers. Also, the impact of policies is fairly large when farm output is held below domestic demand.

Food Expenditures
Monitored

ERS researchers estimated that 1985 food expenditures were 15 percent of disposable income, down from 28 percent in 1969 and 61 percent in 1921. Food stores sell 91 percent of all food for home consumption; supermarkets alone sell 61 percent. Restaurants account for 40 percent of away-from-home food sales, fast food outlets 30 percent, schools and colleges 10 percent, and hotels and motels 5 percent.

Conservation Reserve
To Affect Prices

ERS researchers estimated that the shift of almost 23 million acres from production into the Conservation Reserve Programs (CRP) will raise crop prices and land values but will not (on average) affect employment, income, or output at the national and State levels. However, local markets, agribusiness, and rural economies may be significantly affected where CRP participation is concentrated.

AGRICULTURAL COOPERATIVE SERVICE

The Agricultural Cooperative Service (ACS) provides research, technical assistance, and information and education for the Nation's 5,369 farmer-owned cooperative businesses. The Agency is the information source within Government when issues of policy, legislation, or regulation concerning farmer cooperatives arise.

Senate Directive on Future of Cooperatives	In its FY 1987 budget, the Senate Agricultural Appropriations Subcommittee directed ACS to "conduct a study on what cooperatives need to do to remain viable businesses and increase returns to producer members." The completed report, "Positioning Farmer Cooperatives for the Future," was submitted to the Senate on October 1, 1987. The report focused on the evaluation of traditional and alternative practices available to cooperatives as they strive to fulfill the needs of contemporary farmers, while balancing the pressures of the changing business environment with the need to adhere to fundamental cooperative principles.
Volume of Agricultural Cooperative Business Down in 1986	The combined business volume of 5,369 agricultural cooperatives fell almost 11 percent from 1985 levels to \$58.4 billion in 1986. Net margins of about \$700 million were down nearly 10 percent from the previous year. The decrease in business volume was attributed primarily to lower prices and decreased volume of marketed grain as well as lower prices and diminished use of fertilizer and petroleum.
Cooperative Theory Revisited	Nine papers written to stimulate research and thinking on cooperative theory were completed as part of cooperative research agreements with several land-grant universities. Cooperative theory was examined as it relates to operations, market behavior, decision making, finance, and other aspects of farmer cooperation.
Cooperative Role in Apple Industry Highlighted	Research documenting the role of cooperatives in the U.S. apple industry was completed in 1987. Sixty-four apple marketing, processing, and bargaining cooperatives accounted for 27 percent of the total U.S. apple crop in 1984. They were responsible for 17 percent of fresh apples and 41 percent of processed apples.
Cooperative Export Activity Measured	Results of a survey of agricultural exports by cooperatives were reported. Eighty-seven cooperatives reported exports valued at \$3.39 billion in 1985. Grains and feeds accounted for \$1.7 billion, followed by cotton, oilseeds, fruit products, and nuts. The cooperative share of U.S. agricultural exports was 11.7 percent. Southeast and East Asia provided the largest market for cooperative exports.

Revenues and Assets of Top Cooperatives Down in 1986	Total revenues of the Nation's largest 100 cooperatives were \$42.6 billion in 1986, a decrease of 9.7 percent from 1985. Total assets were down 1 percent to \$15.5 billion. Net worth as a percentage of total assets remained unchanged at 35.9 percent. Net margins (after losses) decreased 33.7 percent to \$198 million.
Cooperative Joint Ventures Studied	A study was completed that presents guidelines for cooperatives to follow in deciding whether to enter into a joint venture with other cooperatives and how to structure it. Included are case studies of four successful joint ventures of dairy cooperatives.
Efficiency of Dairy Cooperative Members Studied	Technical efficiency in milk production of dairy farmers who were cooperative members compared to those who were not cooperative members was studied. No statistically significant difference between the two groups was found. However, differences among farmers belonging to different cooperatives were significant. Socioeconomic characteristics such as education, years of dairy experience, herd type, location of farm, type of milking system, and per-cow inputs were significant factors for differences in the technical efficiency of dairy farmers.
Financial Profile of Grain Cooperatives Presented	Information on the physical and financial structures of 895 local first-handlers of grain with sales of at least \$1 million are included in a report completed in 1987. Financial stress in many of these cooperatives is evident in that 16 percent had net operating losses, averaging more than \$112,000 per association.
Structural Changes in Regional Cooperatives Researched	A study completed as part of a cooperative research agreement with the University of Missouri looked at structural changes in regional cooperatives handling milk, rice, cotton, grain, and fertilizer. The focus is on the relationship of regional cooperatives with members; changes in relationships with members, other cooperatives, and investor-owned firms; and performance of various structures.
Technical Assistance and Education	ACS was involved in 66 formal technical assistance projects in 1987. These involved 92 cooperatives and producer groups. Thirty-eight projects involved emerging and developing cooperatives and producer groups representing more than 5,000 members. Fifty-four projects were carried out on behalf of established cooperatives. A number of these projects involved merger feasibility, cost studies, marketing alternatives, and alternatives to traditional row crops.

ACS responded to 1,941 requests for information and distributed a total of 110,770 publications in FY 1987. The Agency also has an important role in providing education to the international cooperative community. It hosted 157 foreign visitors in 1987, briefing them on Department functions and policies as well as various aspects of U.S. agricultural cooperation.

ANIMAL AND PLANT HEALTH INSPECTION SERVICE

The Animal and Plant Health Inspection Service (APHIS) conducts research and methods development on Animal Damage Control (ADC) through its Denver Wildlife Research Center (DWRC) at Denver, CO. The research is aimed at developing new knowledge necessary to combat vertebrate pests that destroy America's agricultural production. Knowledge and tools resulting from this research are used to reduce wildlife conflicts with agriculture. DWRC works to transfer existing technology to broader uses in control of animal damage. DWRC also collects scientific information for new chemical registrations and for maintenance of existing registrations with the Environmental Protection Agency.

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| Baiting Research for Coyote Control | Use of baits for selective coyote control potentially offers an inexpensive means of reducing predation on sheep and other livestock. Field and pen studies to determine coyote acceptance of small baits were conducted in Idaho and Utah. Physiological marking agents were incorporated in baits to simulate the use of toxicants or other chemicals in the field. Bait placement and bait density variables are being studied by recovering scats or by analyzing coyote blood to determine the proportions of local populations that consumed baits. Marking trials have indicated that up to 50 percent of the coyotes consume small baits in field applications. Current work seeks ways to substantially increase this percentage. |
| Sheep Protection on Public Lands | Field tests were completed using portable, multi-stimulus frightening devices to protect sheep from coyote predation. Fifteen trials were conducted on summer grazing allotments on public lands in mountainous areas where other methods of predation control are exceptionally difficult due to rough terrain, limited accessibility, and land management policies that restrict some techniques. The portable devices, which produce flashes of intense light and intermittent high-frequency sounds randomly throughout the night, appear to be effective in reducing coyote activity near bedgrounds without disturbing the sheep. Prototype devices have been provided to ADC operational personnel and to wildlife Extension personnel for further evaluation. Designs, circuit diagrams, and test data have also been provided to interested manufacturers for possible commercial production. |
| M-44 Cyanide Ejector for Coyote Control | An M-44 is a mechanical spring-powered device designed to propel a measured amount of sodium cyanide in a plastic capsule into the mouth of a coyote. To develop an overview of this technique's performance since its reregistration in 1975, ADC compiled records of M-44 efforts and animals taken in 15 western States from 1976 through 1986. The number of coyotes taken annually by M-44's doubled from 1981 through 1986. This period |

coincides with a concerted research and development effort to improve M-44 ejectors and capsules. A study was begun in Montana to compare lubrication treatments to reduce device malfunctions because of corrosion. Another study was initiated to determine if prototype transparent plastic capsules could replace the opaque polyethylene capsules used now. A transparent capsule would allow easier inspection of the condition of the cyanide so that caked or defective capsules could be rejected before use.

Evaluation and Reregistration of Agricultural Rodenticides

Data required to reregister two strychnine rodenticide labels for ground squirrel control were submitted in reports to the Environmental Protection Agency. These reports provided information on the comparative efficacy of various concentrations of strychnine-treated baits fed to five ground squirrel species. The effective concentrations varied considerably among species, ranging from 0.08 to 0.50 percent.

Food Flavoring Developed as Bird Repellent for Waterfowl

Use of flavor chemicals that are selectively repellent to birds might decrease depredation problems in feedlots and reduce nontarget hazards associated with some agricultural toxicants. One candidate repellent is dimethyl anthranilate (DMA), a human food flavoring that is repellent to birds but not to livestock. In addition to DMA, several other derivatives showed promise as candidate flavor repellents. Tests of DMA efficacy against grazing by free-ranging Canada geese and feeding by penned mallards and ring-necked pheasants suggested that DMA may be effective in reducing damage by these species.

Nontoxic Rice Coating Tested as Bird Repellent

Clay-based nontoxic rice seed coatings were developed and tested for repellency to red-winged blackbirds. Excellent repellency was obtained in tests with caged birds. Germination of the coated seed was not adversely affected.

Improved Delivery System for PA-14

A portable, single-nozzle, water cannon and chemical injector pump system used to apply the wetting agent PA-14 to roosting blackbirds and starlings was tested at four roosts in Kentucky, Tennessee, and Alabama. An estimated 84 percent of the roosting populations were killed in the treated areas. Kills ranged from 64 percent to 100 percent. Advantages of the portable water cannon and injector pump system are its ease of setup and operation, ability to cover roosting vegetation as high as 75 feet, and low operating cost.

Frightening Devices for Canada Geese

Alarm/distress calls of Canada geese were evaluated alone and in combination with racket bombs to determine the bombs' utility in frightening Canada geese from nuisance situations at two sites in Tennessee. The devices were shown to be effective in reducing goose numbers.

Increases in
Gull Population
Documented

An analysis of gull population trends on Lake Erie indicated a 21-fold increase in numbers of ring-billed gulls and a 7-fold increase in herring gulls since the 1950's. Similar increases have been reported on Lake Ontario. Although the use of distress calls and overhead wires has solved some of the increasingly common damage and nuisance problems caused by gulls, population management programs may need to be initiated in the future. Gull population analyses provide the foundation for developing and justifying such management programs.

Electronic
Enhancement for
Research

Improved design and miniaturization of radio transmitters have enhanced the ability of researchers to obtain essential information on the field efficacy of lethal and nonlethal control methods. Prototype development continued to convert electronic equipment assembly to a new process called surface mount technology, in an effort to further miniaturize and increase the reliability of transmitters.

HUMAN NUTRITION INFORMATION SERVICE

The Human Nutrition Information Service (HNIS) develops, through applied research, information required to improve public understanding of the nutritive value of foods, the nutritional adequacy of food supplies and diets, and the selection of nutritious and healthful diets. The Agency compiles information on food composition, monitors food and nutrient consumption by U.S. households and individuals through national surveys, and develops materials and techniques to help Americans improve their nutrition and reduce risk of disease through better diets.

Decennial Food Consumption Survey Initiated

Data collection for the 1987 Nationwide Food Consumption Survey (NFCS) was begun in April 1987. This survey is conducted at approximately 10-year intervals to monitor food consumption and dietary practices by households and individuals. Planning for the 1987 NFCS was coordinated with DHHS's National Health and Nutrition Examination Survey (NHANES) III (which is to begin in 1989) to make questions, procedures, and data bases compatible.

Survey's Nutrient Data Base Compiled

A computerized nutrient data base to be used in both the 1987 NFCS and NHANES III was developed by Agency scientists. The data base includes the content of 27 food components in over 5,000 foods that Americans report they eat. The data base will be used to calculate the nutrient content of food intakes.

Eating Behavior and Nutrient Levels Reported

Food and nutrient consumption by women, young children, and men were reported from the 1985 and 1986 Continuing Survey of Food Intakes by Individuals. Six of nine planned reports have been published, presenting evidence of dietary change since the last decennial Nationwide Food Consumption Survey in 1977-78. Plans have been made to reinstate the Continuing Survey in 1989-93 for all individuals.

Operational Plan For National Nutrition Monitoring System

The "Operational Plan for the National Nutrition Monitoring System" (NNMS) 1987-96 was developed jointly by USDA and DHHS and sent to Congress. The plan describes progress achieved during implementation of the NNMS from 1981 to 1986 and presents the goals and activities to be achieved during this operational phase. An expert panel on nutrition monitoring has been established through a contract with the Federation of American Societies for Experimental Biology. The panel will assist in a second report to Congress that will update the dietary and nutritional status of the population, based on data from the NNMS since the first report published in 1986.

Data on Nutrient Content of Fish Revised

The revised section on finfish and shellfish products (AH 8-15) in Agriculture Handbook No. 8, "Composition of Foods," was published. This section updates and expands the nutrient data for fish, last revised in 1963. Also published was the section

on legumes and legume products (AH 8-16). To date, 16 of 22 planned sections have been published. A research report presenting the sugar content of more than 500 selected foods was also published.

Dietary Guidelines
Promoted

To promote the USDA/DHHS "Dietary Guidelines for Americans," a "Dietary Guidelines Teaching Kit" was published for high school home economics teachers to use in teaching Dietary Guidelines concepts to students in junior and senior high schools. A set of bulletins is being developed to help the public incorporate the Guidelines in food selections at home and when eating out. A consumer marketing firm is being used to incorporate consumers' attitudes in the design and evaluation of the bulletins.

Cost of Food at
Home Published

The cost of four USDA family food plans--thrifty, low-cost, moderate-cost, and liberal--was released monthly. The thrifty food plan is used as the basis for benefits in the Food Stamp Program.

Nutrients in Food
Supply Estimated

The nutrient content of the U.S. food supply is assessed each year and added to the historical series of annual estimates, dating back to 1909. The 1985 estimates were published in a number of agricultural publications and statistical bulletins. In coordination with the Central Intelligence Agency, a report comparing the U.S. and Russian food supplies was published.

AGRICULTURAL MARKETING SERVICE

Market research and development in the Agricultural Marketing Service (AMS) help to minimize the cost spread between agricultural producers and consumers by finding new ways to increase food-marketing efficiency. The Agency's research and technical assistance program is aimed at assessing the need for new regional food wholesaling and processing facilities, planning modern wholesale food distribution centers and farmers' markets, estimating the market potential for new or expanded production of agricultural products, and conducting method improvement studies for specific food wholesaling and processing activities. The Agency also maintains a matching fund program with State organizations for marketing research.

Market Development Plans for Syracuse, NY

In cooperation with the Central New York Regional Marketing Authority and the New York Department of Agriculture and Markets, AMS has developed plans to revitalize the existing Syracuse market. Plans include over 250,000 square feet of wholesale space and an extensive wholesale and retail farmers' market, when the center is completely developed. Researchers surveyed 129 wholesale firms and a sample of both growers and consumers who use farmers' markets during the field work phases of the project.

New Market Plans for Buffalo, NY

In cooperation with the New York Department of Agriculture and Markets, AMS has completed and released an interim report, "Improved Wholesale Food Marketing Facilities for Buffalo, New York," at a public meeting in Buffalo. The study includes plans for a 110-acre wholesale food distribution center and farmers' market. During the project, interviews were conducted with 166 wholesale firms and a selected sample of produce grower-shippers and present users of existing farmers' markets in an 8-county study area.

Long-Range Planning for Maryland Wholesale Food Center

Field work has been completed for a study of current operations and the potential for further development of the 398-acre Wholesale Food Center at Jessup, MD. The study is being conducted in cooperation with the Food Center Authority, a State agency governing the market. This important market serves Baltimore, MD, and the surrounding area, encompassing a wide variety of food firms. Information will be useful as a guide to long-range planning for the Authority and as a measure of the impact of a modern wholesale food distribution center on the total food-marketing system of the area.

Modernizing Existing Wholesale Food Distribution Centers

A study has been initiated to identify criteria for modernizing the existing wholesale building in the New England Produce Center in Boston, MA. The explosive growth in the variety and volume of products moving through this center has placed severe

strain on the ability of existing buildings to support the business activities of firms in the market. The study will outline proposed modifications in existing buildings and specialized designs for new facilities to provide additional space. Information developed in this study may be helpful as a guide for older centers that are facing the need to expand and modernize existing buildings but are unable to acquire additional land at their present locations.

Catfish Study
for Oklahoma

An analysis of the potential market for catfish raised in southeastern Oklahoma is being prepared for publication. It reports on cooperative work with Langston University to develop models to analyze costs and returns related to various production and marketing systems. Cooperative work with Oklahoma State University on marketing processed farm-raised catfish products has been published and distributed. This tripartite approach to the emerging Oklahoma catfish industry will provide the Red Ark Development Authority with the basic information for production and marketing decision making.

Modular/Metric
Shipping Containers
for Produce

Cooperative work with the United Fresh Fruit and Vegetable Association (UFFVA) is being conducted to realize some of the benefits of modularization (increased storage, transport, and handling efficiencies). A modified modularization using only one size package base has been introduced and is being examined.

Alfalfa Cubing
Study

A study is being conducted to analyze the supply, demand, and market trends of alfalfa cubes in the domestic and international markets and to evaluate the feasibility of constructing and operating an alfalfa cubing plant in southwest Iowa. The market analysis was completed and presented in 1987, and a feasibility analysis is scheduled to be finished in March 1988. The study presents information on alfalfa production and marketing by State and also prices by type of product. Alfalfa exports are discussed by country, port, and tonnage. Exports have increased for most of the products, including cubes, in the last 5 years.

Instrumentation of
Tobacco Grading

A project has been initiated to analyze the feasibility of the use of scientific instruments by USDA graders to assess the quality of tobacco in order to help producers market their product more effectively. This project is being conducted in cooperation with the Tobacco Division, AMS, and involves, to a large extent, implementation of known technology.

Exporting Fresh
Vegetables to
Pacific-Rim
Countries

A cooperative project has been initiated to conduct market research on exporting selected fresh vegetables in refrigerated containers to Pacific-Rim countries. This work will be conducted primarily by the International Marketing Program for Agricultural Commodities and Trades, Washington State

University, with input by AMS. Also, directories of wholesale buyers and sellers will be prepared.

Alternative
Marketing
Opportunities

Studies are conducted in cooperation with universities and State departments of agriculture to help farmers identify market opportunities applicable to their areas and available resources. Work has been under way in two locations in Virginia, one in Oklahoma, and another in Iowa. Technical assistance has been provided to several other States as requested.

Vegetable
Marketing

Market development research is being conducted in cooperation with the Horticultural Producers Federation to help small farmer cooperatives in six Southeastern States enter and compete in the wholesale vegetable markets. The research is directed toward assisting cooperatives to improve efficiency through implementing marketing and management tools, standardizing packages and materials, and adopting quality control programs. The Federation instituted a centralized marketing program last year to better serve consumer needs while helping small and limited-resource farmers increase their incomes.

Shiitake Mushroom
Marketing Project

As a result of numerous requests for information regarding the potential for small producers entering the shiitake production and marketing system, AMS personnel are responding with both research and technical assistance. The research will assess the size of the U.S. shiitake market and determine the rate of its growth. Also, investigations have been started to determine what strategies can be developed for small producers to position their products in the market. Product differentiation will be a focus of this research. The technical assistance aspects of this project involve the dissemination of current information about developing marketing strategies and objectives.

Potential for
Modularization of
Frozen Food
Containers

Research is being conducted to determine standardized case sizes for high-volume frozen vegetable items. The recommended case sizes may not all be modular, but they will be an intermediate step. The new cases will reduce the number of sizes now in use for these items by one-half. Also, work is being conducted to gather more cost information on the benefits of using modular size cases. Articles have appeared in Frozen Food Report, the official magazine of the American Frozen Food Institute.

Uniform Code of
Produce Items

USDA, in cooperation with UFFVA and the Produce Marketing Association, has formed an industry task force that will soon be incorporated and known as the Produce Electronic Identification Board. The Board has requested and obtained approval from the Uniform Code Council for a unique vendor's number to be applied to fixed-weight packages of produce. A list of fixed-weight produce numbers has been developed and is being disseminated to the industry for final comments. Scanning of nearly all

fixed-weight items will become feasible in the near future. Work has begun on standardizing the coding of bulk and random-weight packages of produce.

OFFICE OF TRANSPORTATION

The Office of Transportation (OT) helps assure that an efficient and equitable transportation system serves the needs of agriculture and rural areas. This is accomplished through research on specific transportation problems, analysis of agricultural impacts of policy changes and proposed changes, and informational assistance to shippers of agricultural commodities and carriers.

Technical Assistance for Preservation of Rail Service

OT provides technical assistance on a localized basis as particular problems are identified. During the last 2 fiscal years, this has included the States of North Carolina, Mississippi, and Iowa. In Mississippi, for example, OT assisted shippers to retain service on a 24-mile rail line that was scheduled for abandonment, by helping the local economic development agency purchase and operate the line. In Iowa, OT is providing shippers with assistance and expertise on the methods available for preserving service on a 37-mile line used to move 1,500 carloadings of grain per year.

Commercial Drivers License

OT participated in the U.S. Department of Transportation's regulatory proceeding on the Commercial Drivers License (CDL) by filing comments concerning its impact on the agricultural community. Presently the regulations make the CDL mandatory for (1) operators of trucks with a gross vehicle weight (GVW) of over 26,000 pounds and (2) operators of trucks that transport hazardous materials that require visible notification placed on the equipment regardless of the GVW. In its comments, OT requested that the exemption from CDL regulations for 26,000 pounds and below also apply to the movement of hazardous materials by farmers.

Financing Rural Roads and Bridges

During the past 2 fiscal years, OT expanded its study of rural road and bridge financing by building on previous studies of towns and townships in the four Midwestern States of Illinois, Minnesota, Ohio, and Wisconsin. County highway superintendents in each State were surveyed to obtain a more complete picture of the rural road and bridge conditions, financing methods, and policy alternatives. These town/township and county findings are reported in "Financing Rural Roads and Bridges in the Midwest" and in "Rural Roads and Bridges in the Midwest: Finance and Administration by Counties."

Fourth International Conference on Low-Volume Roads

OT cosponsored and participated in the Fourth International Conference on Low Volume Roads at Cornell University. The conference, also sponsored by the Forest Service and DOT's Federal Highway Administration, was held under the auspices of the Transportation Research Board. It attracted about 300 people representing 26 countries and 46 States. The program

focused on the design, construction, maintenance, and management of low-volume roads.

Rural Passenger Transportation

OT in conjunction with the United Bus Owners of America (UBOA) held several interagency meetings to address the intercity passenger transportation problem as a result of recent abandonments of service by major intercity bus carriers. OT now cochairs with UBOA the Rural Transportation Planning Committee, which was formed to address the intercity passenger transportation problems and to identify workable long-term solutions.

OT Team Completes Pacific-Rim Port Survey

An OT team completed a survey of ports and related facilities in the five Pacific-Rim countries of Korea, Japan, Peoples Republic of China, Taiwan, and the Philippines. The primary purpose of the survey was to determine the capabilities of major ports in these countries to handle agricultural bulk, break bulk, and container traffic originating from the United States. Physical inspections and evaluations were made of 15 major ports and terminal facilities along with interviews of port and regulatory officials, importers, and other knowledgeable persons. A report of the findings is available.

Value-Added Export Study

Fresno State University and OT cooperated in a study to determine domestic and international transportation constraints to exporting various agricultural products. Commodities included in the study are those the USDA has designated under the Targeted Export Assistance Program and other value-added or high-value products that California has traditionally exported in volume or may export in the future. The study was completed and a report is available.

Modification of USDA Inspection Requirements at Border Points

To control entry of prohibited plants and pests, the Animal Plant Health Inspection Service (APHIS) has performed physical inspections of all vehicles crossing the Mexican-U.S. border, including railcars. During the summer of 1987, this led to border congestion problems and delay in across-the-border trade. OT assisted in negotiating a compliance agreement between APHIS and a railroad, which allowed spot inspection of certain types of railcars on the U.S. side of the border, instead of in Mexico as is usually done. This modification in inspection rules has helped alleviate congestion along the border and has contributed to more efficient rail interchange.

Tropical Products Transport Handbook

A Tropical Products Transport handbook was completed by OT. This publication emphasizes postharvest practices that are needed to maintain the quality of fruits, vegetables, plants, and flowers during transportation. Purchases of tropical fruits, plants, and cut flowers for both home and business have increased in recent years. This handbook will help growers,

shippers, carriers, and receivers reduce postharvest losses and expand the markets for these very perishable high-value products.

Technical
Assistance for
Bee Exporters

OT met with two Texas bee companies concerning the loss of more than 1,000 packages of bees exported to Germany and Saudi Arabia. The bees died because of inadequate ventilation in the cargo holds of the jet aircraft that transported them. A meeting was held with the carrier and shippers to set corrective procedures for future shipments.

Evaluation of
Grain-Transfer
Technology

OT led a USDA-industry team in evaluating the potential of using a newly developed pneumatic transfer system for more efficient unloading of grain at foreign ports. This evaluation was conducted at the request of the Maritime Administration (MARAD). The team tested samples of grain after transfer through a small-scale pilot system and examined projections of economic savings conducted for MARAD. The team concluded that no hard conclusions can be drawn unless a commercial-scale transfer system is built and compared to existing equipment.

Ocean Liner
Service
Directory

Transport specialists completed an Ocean Liner Service Directory, which provides highly detailed information on the various services available to agricultural shippers on ocean liner routes between the United States and its foreign trading partners. The directory also provides information on ocean and air carrier rates and services.

OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT

The mission of the Office of International Cooperation and Development (OICD) is to coordinate and conduct the Department's international programs in agriculture and related fields.

International research and education programs include scientific and technical exchanges, administration of collaborative research, representation of USDA and U.S. Government research and educational interests in international organizations, and training and facilitation of private sector involvement in agricultural development and cooperation. Programs are conducted cooperatively with other USDA and U.S. Government agencies, universities, and the private sector.

Collaboration With Brazil on Asian Honeybee Mite

The Asian honeybee mite, a parasite that causes one of the most serious known honeybee diseases, threatens the United States \$130 million honey crop and the pollination of many other agricultural crops. The mite, which several years ago brought European beekeeping to a standstill, was found to be in the United States in 1987.

A long-term collaborative research project involving scientists from Cornell University and Brazil was recently completed. Its results have increased the understanding of the biology of the mite and how to control it. Cornell researchers also discovered that African honeybees are highly resistant to attacks by the mite. To avoid dependence on chemical control of the mite, these scientists are studying ways to combine the best qualities of several races of honeybees to produce a bee that is a good honey gatherer and pollinator and, at the same time, mite resistant.

In an article on January 25, 1988, The Washington Post highlighted the research of Cornell University and the University of Sao Paulo on the Asian honeybee mite.

Study of Animal Disease in Egypt

United States-Egyptian cooperative research is expanding the knowledge of animal disease surveillance methods. Research activities include serosurvey, clinicopathological investigations, parasitological survey, and other studies. The project focuses on the six most serious viral and parasitic diseases affecting animals: rinderpest, bovine viral diarrhea, infectious bovine rhinotracheitis, bluetongue, foot-and-mouth disease, and African horse sickness. Rinderpest, the most serious of these diseases, affects mainly cattle and buffalo in Egypt (the most recent epidemic was in 1982-83).

The project is an organized investigation of the prevalence of pathogens, leading to a better understanding of pathogens,

disease epizootology, and factors influencing disease spread. The isolation of local disease strains allows researchers to identify and determine the pathological and antigenic characteristics of diseases. This information will be helpful in developing scientifically based control and eradication programs. Over a 6-month period (October 1986 through March 1987), blood samples were collected from animals of 10 areas, tested for 6 viral diseases, and examined for parasites. The second year of the 5-year study has been completed.

Postharvest
Research With
Israel

The preservation of harvested fruits and vegetables until they reach the consumer is a major research concern of the United States-Israel Binational Agricultural Research and Development Fund (BARD). A good portion of BARD's ongoing postharvest research deals with finding nonchemical or low-chemical means of preserving fresh produce in storage. Examples are curing apple and citrus wounds that allow easy entrance to pathogens, heat and radiation treatments to surface-sterilize fruits, use of natural products to control and monitor storage insects, and use of natural compounds to control ripening and decay.

Among the U.S. locations where this research is under way with the collaboration of Israeli institutions are Rutgers University, New Brunswick, NJ; USDA/ARS at Winter Haven, FL; Cornell University, Ithaca, NY; University of California at Davis and at Riverside; and USDA/ARS at Fresno, CA.

Research on Insect
Control With
Netherlands and
France

USDA and University of Georgia scientists, cooperating with Dutch and French researchers on interdisciplinary long-term research on the biological control of pests, are investigating effective and environmentally safe pest management technologies by studying the foraging behavior of beneficial insects. Pests such as the corn earworm cause annual damage of over \$1 billion to crops, including corn, cotton, soybeans, and selected vegetables.

Breeding of
Triticale and Rye
With Poland

Triticale, a hybrid of bread and durum wheat crossed with rye, combines the best characteristics of both grains. The Polish winter triticale-breeding program is considered the strongest in the world.

In Poland, Special Foreign Currency Research for screening, selecting, and breeding winter triticale and rye enables the United States to transfer Polish germplasm and biochemical information to U.S. selection and breeding programs for adaptive varieties. The Polish germplasm and biochemical information from this research are helping U.S. researchers to develop new cereal grains to expand the production of these agricultural crops.

Fruit Set Research
With Spain

Unreliable fruit set in such commercially important crops as pears, peaches, cherries, and kiwifruit is a major limitation on profitable fruit production in Spain and the United States. Under the provisions of a 3-year research project, scientists at the University of California/Davis and the Departamento de Fruticultura in Zaragoza, Spain, are taking a new look at the physiological and structural mechanisms controlling fruit set.

The project will provide a fundamental data base of the key factors influencing fruit set. Excellent progress has been reported on establishing bases of the reproductive biology of fruit trees. Research results have been published in three journal papers.

Examination of Peach
Tree Growth With
Spain

"Own-rooted" versus grafted peach trees are being examined under terms of a United States-Spain research project with the cooperation of the University of Georgia and the Spanish Ministry of Agriculture's regional research station at Zaragoza. The general trend toward high-density planting and the need to reduce production costs are forcing new strategies in growing peach trees. Growing grafted trees has become the norm in peach production. Although so-called own-rooted trees may be less expensive to plant, growers are reluctant to try them until more is known about the performance of this type of plant under a variety of growing conditions.

Preliminary results show own-rooted trees withstanding the effects of drought better than grafted trees. The results hold important implications for growers where water stress is a limiting factor.

A paper on this work was presented at the March 1987 International Dwarf Tree Meeting. A second paper was presented at a 1987 meeting of the American Society for Horticultural Science. An abstract of the second paper has been published in HortScience, a publication of the American Society for Horticultural Science.

1988-89
Exchange Program
With Russia

The U.S.-U.S.S.R. Joint Working Groups on Agricultural Economic Research and Information (ERI) and Agricultural Research and Technological Developments (RTD) met September 9-11, 1987, in Washington, DC. At that time, the Groups agreed on 31 topics on which to exchange teams. (Sixteen of these were topics for U.S. visits.) The Groups formally recommended these topics to the U.S.-U.S.S.R. Joint Committee, which met January 25-26, 1988, in Washington, DC. Mr. Yevgeniy I. Sizenko, First Deputy Chairman, GOSAGROPROM (the Soviet Ministry of Agriculture), headed the Soviet delegation. Mr. Peter C. Myers, Deputy Secretary of Agriculture, headed the U.S. delegation. All 31 teams recommended by the Joint Working Groups were found to be

acceptable. Agreement was also reached on the exchange of scientific and technical information and on the long-term exchange of scientists. Issues that still require resolution are a recommendation by the Soviets for the signature of a bilateral agreement for a Convention on Plant Protection and Quarantine and the future of the Young Agricultural Specialists' Exchange Program (YASEP). In the former case, the U.S. side agreed to review current bilateral agreements that the Soviets have negotiated, to determine if such an agreement is feasible between the United States and the Soviet Union. In the latter instance, the National 4-H Council, sponsor of the YASEP program, has been unable to raise sufficient funds from the private sector (approximately \$250,000) to run the program. The Soviets, however, would like the United States to continue to seek funding.

Germplasm
Exchange With
China

Renewed cooperation with China in the field of agriculture has fostered a high-priority germplasm exchange program, which began with a 1987 exchange of peanut germplasm. An ARS plant pathologist traveled to China in August 1987 to deliver U.S. peanut seeds and receive several high-quality varieties of Chinese peanut germplasm.

The renewal of soybean germplasm exchange is expected to take place in September 1988. Researchers from ARS, American Soybean Association, Iowa Soybean Association, and Iowa State University will travel to China to compare varieties of U.S. and Chinese soybean plants in the field. An exchange of seeds is planned for the spring of 1988.

Through the successful exchange of high-quality seeds, the United States and China can mutually benefit from an increased germplasm reserve.

Study of Meishan
Swine With
France

The University of Florida, Gainesville, and the National Research Council of France (INRA) are working together on the reproductive biology of a highly prolific breed of Chinese swine, the Meishan, under the USDA-INRA program of cooperation in agriculture. The French have imported Meishan swine for experimental purposes. Thus far, they have not been imported by the United States because of disease concerns. Thus, the USDA-INRA program provides a unique opportunity for U.S. researchers to study the Meishan in a western research facility.

Earlier joint work indicated that prolificacy is associated with low embryonic death rates, rather than higher ovulation rates or larger reproductive tracts. During FY 1987, a research team from the University of Florida and their French counterparts concentrated on identifying the factors that allow the Meishan uterus to routinely retain 18 embryos to maturity. This

involved a 6-week experimental schedule comparing uterine flushings from the Meishan swine with flushings from the European Large White Swine. Preliminary results indicate substantial biochemical differences. The data are being analyzed to draw further insights that will help to increase the prolificacy of U.S. domestic hogs, thereby improving the economic productivity of U.S. hog farmers.

Study of
Firefighter
Health and
Safety in
Australia

During 1987, two USDA Forest Service fire-fighting experts traveled to Australia to learn about recent Australian advances in fire-fighting safety. While there, the Forest Service experts studied the effects of carbon monoxide and other gases in the wildland environment, state-of-the-art personal protective clothing and equipment, fire suppression strategies to reduce adverse safety and health effects, followup treatment for illnesses and injuries in the field, field applications of preventive measures, and physical and mental effects of heat stress. Upon their return to the United States, they used what they had learned to train National Guardsmen to safely fight the disastrous forest fires that raged through the Western United States last fall.

Africanized
Honey Bee
Symposium

OICD cosponsored an International Conference on Africanized Honey Bees and Bee Mites at Ohio State University March 30-April 1, 1987. Representatives from 22 countries, 14 universities, several Government Agencies, and a number of U.S. private-sector companies met to discuss the future impact of Africanized bees and bee mites (*Varroa* and tracheal) on beekeeping and agricultural practices worldwide. Africanized bees are of particular interest because of their rapid northward spread from Central America, their potential public health hazard, and their possible disruptive effect on American crops (valued at \$20 billion) that are pollinated by managed European honeybees. To assist beekeepers and others who were not able to attend the conference, a live teleconference was conducted via satellite hookup, with the help and guidance of the Ohio Cooperative Extension Service.

FOREST SERVICE

The Forest Service (FS) research program is responsible for developing scientific and technical knowledge to enhance the economic and environmental values of America's 1.6 billion acres of forest and associated rangelands. Research is generally long range and high risk, covering a wide spectrum of biological, economic, engineering, and social disciplines.

Research is conducted through eight regional forest and range experiment stations and the Forest Products Laboratory at Madison, WI. More than 2,800 studies are in progress. Approximately 715 scientists are stationed at 76 locations throughout the United States, Puerto Rico, and the Pacific Trust Islands.

Fire and Atmospheric Sciences Research

To be sure managers can continue to use prescribed burning for vegetation control, researchers at the Pacific Northwest Station are assaying the size of particles in smoke and verifying their origins. New computer models can predict the amount of emissions from a prescribed burn. In the South, the Forest Service's Topographic Air Pollution Analysis System predicts the atmosphere's capacity to disperse forest smoke. This system helps managers select the best times for using prescribed fire.

Scientists at the Pacific Southwest Station established procedures to locate new automated weather stations to diagnose fire-threatening weather conditions. This ties in with efforts to forecast potential fire severity for periods of 1 week, 1 month, or a whole fire season.

By law, Federal agencies must manage and protect "air-quality-related values" in wilderness areas. Until recently, however, no universally accepted standard existed for measuring air pollution and its effects. In 1987, Rocky Mountain Station scientists and 25 Federal and university counterparts developed guidelines to measure factors that could be indicators of pollutants deposited from the atmosphere. These protocols will help forest managers around the Nation establish the current physical, chemical, and biological conditions of wilderness resources, using the same procedures.

Forest Insect and Disease Research

Forest managers can spray chemical or microbial insecticides to suppress populations of gypsy moth, a pest native to Europe. Making use of the insect's natural enemies would be cheaper and safer to the environment; however, only one such enemy--a virus--is established in North American forests. Cooperators from the Northeastern Station and the Illinois Natural History Survey have brought to the United States several strains of disease organisms native to European forests. They have

established at least one species in a Maryland gypsy moth infestation. The presence of this pathogen will curb the gypsy moth by enhancing the action of its native enemies, such as viruses, that attack stressed moths.

At the Pacific Northwest Station, investigators have developed a synthetic sex attractant that mimics the scent of female ponderosa pine tip moths and confuses the males of this destructive species. In one test area, use of these synthetic pheromones reduced larval populations as much as 83 percent, and shoot damage to young pines fell proportionately. This control method is target-specific to the pest and is environmentally safe.

Forest Inventory and Analysis

Information from forest inventories is required by both industry analysts and State resource planners. To be useful, the inventories must be up to date and easy to retrieve and interpret. In 1987, the Agency inventoried 45 million acres, which translates into an inventory cycle of 10 years nationwide. In the North Central States, FS data were made accessible on a computer through the University of Minnesota. In the South, two data-retrieval packages were created for information requestors. The Agency has also standardized its data sets nationwide and made its raw data available to persons who want to perform their own data analyses. Some tree species have been growing more slowly in New England since the early 1960's, and "acid rain" is a suspected cause. But research on cores from the trunks of 23,000 trees indicates that growth declines in red spruce and balsam fir are not due to atmospheric deposition but to the normal aging process for spruce-fir stands.

Research on Renewable Resources Economics

The relative worth of research may be determined by the answer to one question: By how much does the value of the products of research exceed the cost of producing them? North Central Station economists analyzed the value of research on containerized tree seedlings by calculating the rate of return on the investments leading to the containerization technology. They calculated the average internal rates of return from the investment in this research at 37 to 111 percent. These results suggest that research on containerized seedlings was a profitable investment for the United States. Related investigations support the conclusion that the rates of return on forestry research are at least equivalent to those for agricultural research.

Countries of Western Europe and the Pacific Rim account for the second-largest share of U.S. hardwood exports. But these nations want rough-dimension lumber in sizes that differ from the American standard. Northeastern Station researchers have developed a set of standard sizes for these markets that will

make importing U.S. timber extremely attractive. The big advantage is that these new standard sizes can be made from abundant second-quality hardwood lumber.

Research on
Trees and
Timber Management

Southerners are concerned that herbicides used to control unwanted vegetation in pine plantations could contaminate drinking-water supplies. Studies at the Southeastern Station indicated, however, that application of three popular herbicides in Florida did not affect the quality of groundwater near the surface. Herbicide residues degraded rapidly in the warm, humid environment. Repeating the experiments in the steeper terrain of Georgia's Piedmont and the Appalachian Mountains proved equally reassuring.

Before FS can use biotechnology for improving forest trees, much more must be learned about how parents in tree species pass genes to offspring. Studies of pines at the Pacific Southwest Station revealed that the genes responsible for key reactions in photosynthesis (and ultimately in the making of wood) are inherited strictly through the paternal parent line. Genes responsible for respiration, which makes energy available for plant growth, derive from the maternal parent only. Therefore, to improve photosynthesis or woodmaking, biotechnical methods must be applied to the male (pollen-bearing parent). To improve energy metabolism, the techniques must be applied to the female (egg-supplying parent). The situation is exactly opposite in most crop plants (where the principles of biotechnology have been more widely applied to date).

Watershed
Management
and Rehabilitation
Research

Fish habitat in southeast Alaska can be damaged when unstable slopes erode, depositing soil and debris in stream channels. The land's ability to regenerate forests is also impaired when organic layers and mineral soil wash away--an event that may follow clear-cut logging. Cooperative research between the Pacific Northwest Station and Oregon State University has led to the development of engineering and hydrologic data bases for southeast Alaska, plus a risk-assessment procedure that can help spot potentially unstable natural slopes before they are logged or selected for road-building sites.

In the arid Southwest, the fragile green corridors that shade meandering streams are critical wildlife habitat, especially for breeding birds. Stream hydrologists and wildlife biologists at the Rocky Mountain Station have discovered how to use dams and bank-protecting structures to modify channel flow and influence sediment deposition. This creates conditions favorable for riparian areas and shrubs. Hydrologists are developing guidelines so that land managers can extend and make more secure their riparian ecosystems. At the Intermountain Station, scientists initiated research to develop accurate, repeatable,

and standardized methods of measurement, analysis, and reporting for data on riparian-stream habitats. "Methods for Evaluating Riparian Habitats With Applications to Management" summarizes available tools for evaluating such environments and addresses the broad areas of overlap between the needs of riparian-stream organisms and livestock grazing.

Research on Wildlife, Range, and Fish Habitat

In 1987, researchers at the Pacific Northwest Station and the University of Idaho evaluated how streamside shadecover influences the distribution and abundance of juvenile Chinook salmon, an important local fish species. Studies revealed that numbers of fish and their total weight were two to four times greater in artificially shaded test sections of streams than in adjacent, unshaded control sections. Overhead shade does not supplant submerged cover, such as that provided by rocks and large woody debris, but managers can manipulate overhead shade to foster better rearing conditions for salmonids. Research on black bears native to the aspen-birch-conifer forests of Minnesota has revealed what kinds of habitat managers must encourage if they want to increase black bear populations. The abundance of berries, nuts, and acorns dictates the reproductive success of adults and the survival of cubs. If such foods are in short supply, black bears will travel over 125 miles outside their normal range in search of more hospitable living conditions. To improve the quality of black-bear habitat, forest managers must maintain a variety of food-producing habitats across the landscape, from forest openings to mature, mast-producing forests with closed canopies.

Forest Recreation Research

Working with researchers at the University of Michigan, North Central Station scientists discovered that bigger is not always better for urban forest parks. Park visitors prefer a feeling of spaciousness, but this impression is unrelated to actual or perceived size of the park. By using trees, shrubs, or hills to screen adjacent developed property from view, park designers can achieve the perception of spaciousness in small open areas. Such designs create the illusion that the natural area extends beyond its real boundaries. This research shows that the open-space needs of urbanites can be met even in heavily populated areas with only small parcels available for parkland.

In managing wilderness recreation sites such as trails and campgrounds, managers have to balance the desires of visitors against a mandate to protect extremely fragile ecosystems. Intermountain Station scientists studied the responses of six vegetation types to experimental trampling over 3 consecutive years and found wide variation in damage. Grassland tolerated 10 times as much trampling as the most fragile ground cover within a forest. Thresholds beyond which recreational use had an unacceptable impact varied between as little as one night's

wear and tear and eight nights of camping. This work will help wilderness managers decide where to encourage or discourage camping and where to recommend dispersed rather than concentrated recreation.

Forest Products and Harvesting Research

FS has long been involved in research on the utilization of low-quality hardwoods, especially in devising ways to remove or reduce defects during processing. The concept of "standard blanks," developed at the Princeton, WV, Forestry Sciences Laboratory, greatly increases the usefulness of low-grade timber. Because 80 percent of the wood parts used in making furniture are less than 40 inches long, the industry no longer requires many clear 8-foot specimen logs. Furniture manufacturers can use standard blanks made by gluing together defect-free segments of low-quality logs. A whole new industry has sprung up to fabricate this material for furniture and cabinet manufacturers. In addition, standard blanks have good export potential: both European and Asian countries are interested in purchasing this new product.

With today's technology, it is not commercially feasible to make white paper without using chlorine bleaching compounds, which eventually end up in the Nation's waters. New research at the Forest Products Laboratory should help the pulp and paper industry to eliminate this form of pollution. These scientists have discovered a new way to bleach chemical wood pulps using only calcium or sodium sulfites and air, plus a catalyst. The byproducts of this process are harmless and can be recycled into fresh batches of pulping liquor. Although experiments on this process are only now in the laboratory stage, sulfite-air bleaching could eventually give rise to completely chlorine-free bleach plants for brightening chemical pulps.

International Forestry

The International Forestry (IF) program provides leadership, coordination, and direction for FS involvement in forestry worldwide. In 1987, IF facilitated 26 cooperative research projects in eight countries. These address new technologies in agroforestry, fire management, insect and disease protection, regeneration, tree genetics, watershed management, and wood utilization.

IF conducted 19 science and technology exchanges with 18 countries in eastern and western Europe, Asia, Oceania, and Latin America. FS gained new tree and insect germplasms, data on atmospheric deposition, information on wildlife forestry relationships, and new technology on safety equipment for firefighters.

Two IF programs work closely with the U.S. Agency for International Development and the USDA Office of International

Cooperation and Development, primarily to assist developing countries. The Forestry Support Program provides technical assistance to AID's natural resource projects worldwide as well as to Peace Corps foresters, by helping to design, execute, and evaluate a wide range of field projects. In 1987, the Forestry Support Program did the following:

- o Evaluated a village forestry project in Uganda and a forestry and land-use project in Niger.
- o Analyzed cacao agroforestry practices in Barbados, Grenada, and Honduras.
- o Supported publication and distribution of "Management of the Forests of Tropical America," "Profiles of U.S.A. Forestry Schools," "Buffer Zone Agroforestry in Tropical Regions," "Economic Analysis of Forestry Plantations in Ecuador," and "Job Seekers Guide to Opportunities in Natural Resources Management for the Developing World."

The Disaster Assistance Support Program reached full staffing during 1987. It helps provide the U.S. Office of Foreign Disaster Assistance with prevention, preparedness, training, and emergency relief for global natural disasters. The program's 1987 activities included the following:

- o Fire suppression training in Argentina and Venezuela and on-the-job training in the United States for Chilean and Ghanaian firefighters.
- o Assistance with locust control in Senegal, Mali, and Niger.
- o Assessments of landslide hazards in Dominica and Honduras and earthquake simulation in Peru.
- o An FS operational plan for international emergency responses and a skills-roster process for disaster-related technical assistance and relief.

FEDERAL GRAIN INSPECTION SERVICE

The Federal Grain Inspection Service (FGIS), in the process of fulfilling its mandate to administer the Nation's grain inspection and weighing system, conducts applied research. FGIS is an action-oriented agency with responsibilities for developing new or improved methods and equipment for grading, inspection, and weighing of grain; inspection standards; inspection and weighing procedures; and other grain-marketing services and programs. FGIS needs supportive research to solve problems and improve the efficiency of its inspection and weighing activities. FGIS and the Agricultural Research Service (ARS) collaborate in establishing policies, responsibilities, and procedures for research in grain marketing. The Director, Standardization Division, shares with the Administrator the ultimate responsibility for overall planning, research, and related support programs and activities assigned to FGIS.

Research involving FGIS is carried out (1) in-house and (2) by reimbursable agreement with ARS or by contract with any acceptable vendor through the contracting capability of the Animal and Plant Health Inspection Service. Projects for which the personnel and equipment are available or reasonably obtained are handled in-house.

Soybean Oil and Protein

Work is continuing on the development of a method that uses near infrared reflectance (NIR) to quantify the oil and protein in soybeans. Two further collaborative studies are also under way to determine the accuracy of the calibration and the effect of the grind on resultant oil and protein values. One study is entirely FGIS-based, and the other is a cooperative effort between ARS, State universities, and FGIS.

Development of Corn Sieves

One of the requirements of the Grain Quality Improvement Act of 1986 is the separation of broken corn from foreign material in the grade factor for broken corn and foreign material. A double sieve for use in the Carter-Day dockage tester has been developed by FGIS at the Technical Center in Kansas City. Testing of the sieves is being completed in Kansas City prior to giving the manufacturer the go-ahead to build and offer the screen for distribution.

Grading of Wheat by Hardness

One of the largest and most important projects under way by FGIS at the Technical Center is the determination of wheat hardness. Over 15,000 wheat samples taken from commercial channels will be used for this project. The purpose of all the testing is to obtain some ideas on how grain in regular channels would be graded if a hardness factor for differentiating between classes is used. A comparison between single-kernel and bulk methods of testing will be obtained.

Testing for Toxins and Pesticides	Rapid procedures for determining the presence of toxin residues are being investigated with the evaluation of test kits in the laboratory and in the field. In addition, an analysis of existing pesticides procedures is taking place, with the purpose of developing a procedure that can be readily applied to grain analysis.
Testing for Corn Moisture, Protein, and Oil	Calibrations are being developed for NIR procedures for determining moisture, protein, and oil percentages in corn. This investigation is being carried on to provide more objective testing for grain and to provide test results that are meaningful to end users.
Determination of Insect Infestation By X Ray	Work is continuing on using the X ray as a means of detecting detecting internal insect infestation. The primary difficulty is the positive identification of the insects in the early stages of development in numbers that are exact enough for use in the inspection system. Additional research is being pursued to allow biochemical assaying for insects, or insect fragments, by analyzing for insect chitin or using immunological assay for insect specific proteins. In the case of insect fragments in flour particularly, this method would give a quantitative figure for the degree of contamination rather than the present semiquantitative measures of insect fragments by number only, whether large fragments or small.
Toxicity of Weed Seeds	The toxicity of five different weed seeds that commonly contaminate grain is being researched for FGIS by ARS. Toxicity is being evaluated by extensive animal feeding studies that involve growth- and development-related examination and postmortem tissue and organ studies. Two seed studies have been completed.
Image and Compositional Analysis	Image analysis is being investigated as a means of classifying wheat. A variety may still possess some physically identifying characteristics even though they are not apparent visually. This project attempts to differentiate between specific club and white wheat varieties using image analysis procedures. Research is also being conducted using compositional differences (including protein and enzymatic) to separate the winter and spring classes.
Single-Kernel Moisture	Attempts to develop and evaluate single-kernel moisture procedures and instrumentation continue. Dielectric, nuclear magnetic resonance, and microwave procedures are being investigated. A commercially available Japanese single-kernel instrument is being evaluated for small grains, i.e., wheat and rice. It has been adapted to handle corn.

Identification of
Grain Odor

Continuation of an attempt to develop instrumentation to identify grain odors is being assumed by ARS. This project retains its high priority in attempting to replace the human nose as an instrument for detecting foreign odors in grain. Odors are a highly complex mixture of organic volatiles. Identification of the volatile(s) responsible for a particular odor is an extremely involved project. After determining which compounds cause which odors, the detection system developed for these compounds can be implemented.

EXTENSION SERVICE

The Cooperative Extension system is a three-way partnership encompassing the Extension Service of USDA, the Cooperative Extension Services in each State and territory, and the local Extension offices in nearly all of the Nation's 3,150 counties. Supported by the Federal, State, and local governments, the Extension System cooperates with other agencies and groups in the public and private sectors in its programs. Through this unique structure, Extension educators bring research-based technology and knowledge to bear on national, State, and local issues.

Recently, the Extension System developed eight initiatives that focus nationwide on issues that are critical to the economic, social, and environmental progress of Americans. These initiatives and issues and the model programs associated with them are as follows:

Alternative Agricultural Opportunities

American farmers can reduce their vulnerability to changes in prices and production practices for specific commodities through diversification and alternative enterprises. Options include diversifying practices or products, adding value to products through on-farm processing, and supplementing income through off-farm employment. Through integrated educational programs, Extension helps farms and agribusiness achieve greater profits by evaluating existing enterprises and implementing new ones. Farm families are assisted in improving incomes by exploring nonfarm income sources.

A program that emphasizes diversifying farm operations and making better use of natural resources is leading to increases in commercial vegetable operations, aquaculture acreage, and local processing of seafood products. Acres that were formerly in cotton and soybean production are being converted into more profitable vegetable crops, and crawfish and catfish production is being expanded.

A small-farm educational program aimed at families with gross farm incomes below \$10,000 emphasizes alternative enterprises, provides training in financial management, and supports the development of marketing organizations. "Technicians," who are small farmers themselves, use the one-to-one method to teach families how to adopt new production and marketing practices, establish alternative enterprises, and increase involvement in programs sponsored by Extension and other USDA Agencies.

Building Human Capital

One of the Nation's critical challenges is to invest in education that builds human capital by enhancing the abilities of persons to increase their productivity and quality

of life. Three educational systems--family, formal, and nonformal--work together to build human capital. Nonformal education is the focus of this Extension initiative. It reaches people through communities, the workplace, and public and private institutions. The initiative gives priority to facilitating career preparation and transition, preparing youths for responsibility, developing leaders, and renewing volunteerism.

Innovative programs are under way. "Income and Career Decisionmaking," a program for youths and adults, is concerned with supplementing current income. The program includes individual decision making; learning; lifestyles and work styles for adapting to job, career, and income-earning options; and relating skill, resources, and needs to the job market.

"Is Anyone Listening?" is a program that engages youths in analyzing conditions that affect them in their communities and planning approaches to improve them. "Peer Plus II" helps older youths to learn positive relationships with others, increase self-awareness, and build interpersonal skills. Other programs promote training for outstanding high school students at land-grant universities, building on experience with 4-H projects in veterinary science, animal science, agronomy, food science, forestry, fisheries, and entomology.

Competitiveness and Profitability of American Agriculture

Future profitability of American agriculture will depend not only on optimal production levels but also on competitiveness in the global economy. Potential for profit hinges on efficient U.S. production and marketing systems and also supportive agricultural, macroeconomic, and trade policies. Educational programs in production management, financial management, marketing, and public policy must be integrated and targeted toward increasing the competitiveness and profitability. These programs will develop, apply, and transfer technology; balance human and environmental issues with other goals; strengthen business support systems; integrate production and marketing strategies; and encourage an adequate supply of professionals.

Programs are integrating the production, financial management, and marketing components into consistent packages for producers. A total ranch management program includes setting goals, inventorying resources, identifying alternatives, developing a production process, analyzing each enterprise area, determining the enterprise combination that best meets ranching goals, developing a detailed plan, and projecting monthly resource flows.

An interdisciplinary program--plant pathology, weed and seed sciences, entomology, and agronomy--is targeted toward enhancing

the profitable production of corn and soybeans. Each program practice is evaluated for its contribution to the efficiency and profitability. Other programs provide comprehensive management for dairy and beef producers.

Conservation and Management of Natural Resources

A major challenge in natural resource management is to conserve, enhance, and expand the Nation's natural resources while developing their economic potential to benefit individuals and communities. In addition to profitability, the goals of landowners to be addressed include protecting wildlife, preserving esthetic beauty, and assuring clean air and water. Extension educational efforts are focusing on three critical issues: sustaining a productive natural resource base, marketing natural resource products and services, and providing public policy education on natural resources.

Successful education efforts include a cooperative effort involving the land-grant university, the Forest Service, Bureau of Land Management, the forest industry, counties, and State agencies. Solutions to multiple resource problems associated with simultaneous management of fish, water, wildlife, timber, and other forest resources are sought through research and an intensified technology transfer effort.

Other innovative programs assist both individual and group decision making. An integrated package of computer software for county agents and natural resource professionals assists their work with landowners. Components include computer programs on forestry, wildlife, range, and timber marketing that allow landowners to evaluate management alternatives. Another effort brings people interested in public land issues into a planning process with Agency specialists through a series of participatory decision-making experiments. These groups, using consensus rules of order, successfully forge land-use decisions on resource conflicts.

Family and Economic Well-Being

Today's families live in a rapidly changing world. During the next decade, they will face many challenges as society adjusts to changing demographic, economic, and employment patterns and technological advances. Critical issues include family financial instability, children at risk, vulnerable youths, family disruption and dislocation, and responsibility for dependent elderly persons. Educational programs are needed to assist families in developing decision-making and management skills to deal with these critical issues.

A holistic approach to problem solving is required. In one such approach, Extension is training volunteer financial counselors to provide individualized help with family economic problems. The volunteers, who must exhibit excellent interpersonal

communication skills, are trained in counseling techniques and family dynamics as well as credit control and debt management.

A series of community educational programs, "When Dependency Increases," is based on the premise that families provided with the right knowledge and skills can be an important support system for elders faced with decisions about life changes. Other programs coordinate with existing county programs and resources to help welfare families and teenage parents use the many State, Federal, and county resources available to assist them in becoming self-sufficient.

Improving Nutrition, Diet, and Health

Foods and diets must meet the needs and preferences of a population that is becoming older, more ethnically diverse, and experiencing dramatic changes in family structure and lifestyle. Recognition of diet as a possible risk factor in health problems has increased the demand for reliable advice on dietary practices and has influenced the demand for agricultural products. Consumers are also concerned about the safety, quality, and composition of the food supply and the ability to assess risk to humans and develop acceptable regulations.

The "Intercollegiate Nutrition Consortium" provides a forum for the interaction and exchange of information among disciplines related to food production, food processing, nutrition, and health and also among scientists, educators, and the general public on nutrition and food-related issues. The program is expected to foster the development of models on dietary needs and nutritive values for incorporation in agricultural production research.

"Guidelines to Eating Right" teaches participants to (1) assess diets before making changes, (2) adopt dietary practices that reduce the risk of health problems, and (3) be aware that special dietary practices are nutritious and the foods can taste good too. Food and fitness programs such as the "Fitness Factor," a 6- to 9-week curriculum for elementary school students, help participants make choices leading to a healthier lifestyle.

Revitalizing Rural America

Rural areas are suffering from unemployment, increasing out-migration, underdeveloped human resources, substandard housing, and inadequate infrastructure. Revitalizing rural America is in the best interest of its 63 million inhabitants. It is also in the interest of the entire Nation since rural America not only produces food, fiber, and forest products but also provides stewardship over 90 percent of the land and water resource base. Issues to be addressed in revitalizing rural America include the diminishing economic competitiveness, dependence on too few income sources, growing service demands,

adjustment to change, need for skilled leadership, and maintaining and/or improving the quality of the natural resource base.

In cooperation with other agencies, organizations, and educational institutions, Extension is working to bring about rural revitalization. Community economic analyses, supported by large data bases, provide community-level information to help leaders devise action plans to increase jobs and income.

Business leaders in one rural county have initiated actions to help the county become a leader in apple production and to attract dairy firms to the area. In another instance, a depressed mining community has shifted its economic base to timber. A third community, formerly depressed, has now become a thriving tourist attraction.

The skills of local community leaders are being enhanced. A series of educational programs is teaching municipal clerks how to respond to changes affecting their small towns. In cooperation with continuing education offices of community colleges, Extension is providing convenient and inexpensive programs tailored to the needs of specific groups.

Educating Public on Water Quality

The quality of the Nation's water is of great concern in terms of its potential impact on human health and well-being. Nonpoint pollution, municipal landfills, and septic systems are potential sources of contamination for water supplies. Issues addressed by educational programs are increased public understanding of the nature and importance of water resources, impacts of chemicals on the water supply, the importance of water conservation, and community control of water quality.

Educational programs are being conducted at State and regional levels. The Northeast Regional Center for Rural Development coordinates activities in that region. It sponsors planning and training conferences and has published a widely used set of program materials on groundwater protection and management. Water-quality education for local citizens is provided in many areas through countywide water-testing clinics, handbooks, video tapes, and other media.

Information on the proper management of soils with respect to water is provided through an interactive microcomputer tutorial on soil hydrological properties. This tutorial is used by local planning boards, environmental management councils, Extension agents, and concerned individuals to obtain information on water movement through soils.

NATIONAL AGRICULTURAL LIBRARY

The National Agricultural Library (NAL) serves as the Nation's chief agricultural information resource and service. It provides to the Department and the Nation needed information concerning agriculture, rural development, aquaculture, human nutrition, and related sciences. The library collects information from all over the world, with almost 2 million volumes now in its collection. NAL disseminates information to scientists, administrators, educators, and farmers through its reference and lending services and through specialized information centers and a network of State land-grant and field libraries. NAL is augmenting its dissemination capabilities with sophisticated computer, laser, and optical technologies. It also serves as the U.S. center for an international agricultural information system.

Specialized Information Centers

The NAL has established 12 specialized information centers. The centers focus on topics of current national concern and also work with support groups in industry, Federal agencies, State agencies, and the scientific community. The information centers are

- | | |
|---|--------------------------------------|
| . Agricultural Trade
and Marketing (new) | . Critical Agricultural
Materials |
| . Alternative Farming
Systems | . Family |
| . Animal Welfare (new) | . Fiber and Textile |
| . Aquaculture | . Food and Nutrition |
| . Biotechnology | . Food Irradiation |
| | . Horticulture |
| | . Rural (new) |

The three new centers established in 1987 are described below.

The Agricultural Trade and Marketing Information Center focuses on agribusiness, countertrade (barter), exports, and trade development. These topics have become critical global issues, with new emphasis on trade development in Third World countries and foreign marketing through U.S. farming cooperatives. The Center was formed in response to the concerns of policymakers, agricultural experts, farmers, and consumers. The Center organizes and disseminates information to interested users, and facilitates communication and cooperation among the U.S. Department of Agriculture, private institutions and organizations, and individuals.

The Animal Welfare Information Center (AWIC) focuses particularly on the humane care, use, and treatment of warm-blooded animals in research, testing, and education. The impetus behind the formation of AWIC was provided by an

amendment to the Animal Welfare Act. Under this Act, NAL is charged with establishing a service that will provide information pertinent to employee training, including maintenance of a data base of instructional materials for use by research facilities to enhance uniformity of training. Such information is intended to prevent unnecessary duplication of animal experimentation and to encourage adoption of alternative methods of research, including those that could reduce or replace animal use and minimize pain and distress.

The Rural Information Center (RIC) is designed to provide information and referral services to local government officials who research, develop, support, and implement America's rural development programs. While the mission of RIC is to aid public officials, the Center's services and assistance are also available to any agency, organization, institution, library, and individual seeking rural information. RIC combines (1) the technical, subject-matter expertise of one of its sponsors, the Extension Service, with its nationwide educational network, and (2) the resources of its other sponsor, NAL, with its enormous capacity for providing agricultural information. Through RIC, NAL will expand its national collection by identifying and acquiring new books, journals, program manuals, audiovisual materials, and computer software in the areas of rural and economic development.

NAL Services

Improved service for ARS scientists and staff is the goal of an evaluative study being done by NAL. Library staff are visiting field library sites around the country to discuss ARS information needs and NAL services and products. More effective use of new technologies, improved awareness of the content and in-depth access to NAL's AGRICOLA data base, and rapid response to requests for materials are some of the topics being reviewed.

Also, the rapid availability of books and articles on forestry is enhanced by the assistance of Forest Service staff on-site at NAL. NAL recommends coordinated and consolidated processing to assure more thorough and complete coverage with less overlap and effort.

National Agricultural Text-Digitizing Project

A cooperative project between NAL and 42 land-grant libraries is under way to test a new method of capturing full text and images in digital form for distribution on CD-ROM. Over the next 2 years, an optical scanning workstation with an OCR-like conversion processor will be used to capture materials on acid rain, aquaculture, Agent Orange, food irradiation, and international agricultural research materials for distribution to participants, using a variety of full-text retrieval software.

Publications on
Optical Disc

NAL is evaluating the use of 12-inch optical laser discs as a means for storing, disseminating, and retrieving information from agricultural publications. This approach uses videodisc and optical digital technologies to store both full text and illustrations. A cooperative project for storing and disseminating 13 USDA and Extension publications, now in its second phase, has expanded from 3 to 15 participating institutions. This project identifies problems involved in converting data in various formats to a single format used in creating the discs.

AGRICOLA Data Base
on CD-ROM

The AGRICOLA data base of citations to the agricultural literature, produced by NAL, is being published on CD-ROM. The current disc for citations from 1984 to the present is available on subscription (quarterly updates) from Silver Platter, Inc. Three retrospective discs covering 1970-84 are also available. Other commercial CD-ROM publishers will offer AGRICOLA in 1988. The compact discs run on an IBM-PC or are compatible with a compact disc drive. This type of stand-alone system benefits frequent users by eliminating the cost of on-line telecommunication linkages and associated charges for computer time. The technology is useful in geographic areas where telephone connections to the on-line systems are not feasible.

Forestry Photos
Stored on
Laser Videodisc

A cooperative project explores the use of laser videodisc technology to store photograph collections. A portion of the Forest Service photograph collection, one of the largest on forestry, has been placed on videodisc and joined with a computer-searchable index. Systems are placed for evaluation in various Forest Service regional offices and land-grant institutions. Another project is planned to explore the effectiveness of capturing photographs and storing them, with an index, on the "Write Once Read Many" (WORM) laser videodisc. This disc will allow frequent updating with new images and data. Photographs now in the USDA photo library and other USDA photos will be used for this project.

Technology
Demonstration
Center

A Technology Demonstration Center has been established in the main lobby of the NAL building in Beltsville, MD, to demonstrate several systems that use new computer technologies for the management, retrieval, dissemination, and preservation of agricultural information. Systems currently available are the full-text laser videodisc, expert advisory systems, compact discs, AGRICOLearn (self-instructional interactive videodisc training program), and the Forest Service Photo Collection laser videodisc.

World Lists of
Serials

NAL and CAB International (United Kingdom) are cooperating to create a comprehensive listing of agricultural serials. NAL

will prepare the list, indicating for each title which of the three agricultural systems, AGRIS, AGRICOLA, or CABI, indexes it. CABI will publish the list, which is expected to exceed 60,000 titles. NAL is also preparing a comprehensive list of serial titles related to poultry. This list is expected to cover approximately 1,500 titles. A minicomputer system containing the records will produce printed lists indicating NAL's holdings.

FOOD AND AGRICULTURAL SCIENCE PRIORITIES
AND DIRECTIONS FOR THE FUTURE

DEPARTMENTAL OBJECTIVES

Several of the top 16 USDA objectives for the future, as determined at the Secretary's Top Staff Conference in July 1982, are directly related to the food and agricultural sciences. They are as follows:

Help Farmers
Market Their
Products

Research and education agencies will improve the knowledge and information bases available to agricultural producers concerning presently available marketing alternatives; identify opportunities for developing new marketing alternatives; and provide information, training, and technical assistance to producers that will improve their marketing skills, practices, and strategies.

Provide Technology
for New Crops

Develop a research program that will provide the technology needed to produce new agricultural and forestry crops to meet national needs; provide for crops for arid lands, problem soils, strip-mined areas, and family farms; and develop new crops that will supply new medicinals, gums, waxes, resins, oils, proteins, hydrocarbons, and fibers for industrial use and new crops to replace crops in chronic surplus.

Increase
Efficiency

Conduct fundamental research on the physical and biological aspects of agricultural and forest products and the processes by which they can be preserved, converted into safe and useful products, and transported from producer to consumer; conduct economic research on costs and efficiency in the marketing system and the economic performance of markets for agricultural and forest products; and provide for the extension of technology and market intelligence to producers, marketers, and consumers.

NATIONAL PRIORITIES RECOMMENDED BY THE JOINT COUNCIL
ON FOOD AND AGRICULTURAL SCIENCES

In June 1987, the Joint Council identified eight major priorities for FY 1989 science and education programs. The Council recognizes the importance of strong base programs in research, extension, and teaching and urges the continued support for these programs. In its report, the Joint Council recognized three overriding societal issues--the need to enhance competitiveness and profitability in agriculture, increase family economic strength, and revitalize rural America. The priorities that follow address these issues either directly or indirectly.

Maintain and
Preserve Water
Quality

Groundwater provides the drinking water for over half the total population in the continental United States and for 95 percent of the rural population. Agriculture utilizes 68 percent of all groundwater withdrawn. Providing a long-term water supply of acceptable quality in the presence of sustained agricultural, industrial, municipal, and recreational activities continues to be a major challenge in the United States. A better understanding of erosion reduction management techniques and the environmental fate of chemicals (persistence, mobility, transformation, and degradation in the soil and water systems) is essential to prevent inadvertent contamination of water sources. Additionally, improvements in irrigation management are needed. Urban users must also be further educated in the proper use, storage, and disposal of household chemicals and pesticides.

Expand
Biotechnology and
Its Applications

Biotechnology is a tool through which the competitive position of U.S. agriculture can be enhanced. Emphasis should be on maintaining strict ecological standards while conducting basic biotechnology research and transferring knowledge gained through research to users. Through the application of biotechnology, plants and animals can be made more resistant to naturally occurring pests, diseases, and other environmentally induced stresses. Biotechnology promises opportunities to discover the causes of many diseases and to provide the means by which they can be alleviated, controlled, or eradicated.

Develop and
Maintain Scientific
Knowledge and
Expertise

The continuing development of human capital is critical to the continued success of the Nation's food and agricultural system. Expertise in the agricultural and complementary sciences is of paramount importance if the United States is to regain leadership and a competitive edge in the world economy. To meet this challenge, greater efforts are needed to attract and retain quality students in the food and agricultural sciences, curriculums and faculties need to be improved, and better

information and dissemination on career opportunities are urgently needed.

Educate Public on
Food, Diet, Human
Nutrition, and
Health
Relationships

The relationship between diet and the prevention of some degenerative diseases has been shown to be much greater than previously recognized. More research and education are needed on developing better nutritional surveillance methods and on motivating consumers to improve their nutrition through better eating habits. Educational programs that help people interpret and apply research findings are essential to enhancing the future health of society.

Sustain Soil
Productivity

Maintenance of this Nation's long-term agricultural production capacity requires the wise stewardship of natural resources. Increased basic and applied efforts should integrate economically feasible management scenarios that protect the soil from wind and water erosion, minimize nutrient depletion and contamination, and reduce the need for fertilizers, pesticides, and other inputs.

Develop New and
Expanded Uses for
Agricultural
Products

Production overcapacity currently plagues global agriculture and results in more supply than demand, leading to lower prices and reduced profitability. Profitability can be enhanced by developing innovative uses for existing crops, by growing new crops to satisfy additional demands of processors and consumers, and by converting to other uses land that is currently growing surplus food or feed crops.

Preserve Germplasm
and Genetically
Improve Plants

To help ensure that future agricultural and forestry needs can be met, scientists must continue to actively evaluate, assess, and preserve germplasm. An adequate and continuing supply of germplasm will enable scientists to maintain a wide variety of genetic diversity in plants and to discover the sources of desired traits and the genetic basis for their inheritance.

Improve Food
Processing,
Quality,
Distribution,
and Safety

Over two-thirds of the cost of producing and delivering food to consumers results from postharvest activity, which includes processing, transportation, storage, preservation, packaging, and marketing. Areas that need to be emphasized involve defining the molecular and structural properties of foods, using new electronic and biological technologies, developing new food-processing systems, improving the quality of processed foods, and enhancing methods to assess consumer needs and preferences. Aggressive marketing to increase market shares is of paramount importance.

